SCI
I68

CONSEIL PERMANENT INTERNATIONAL POUR
L'EXPLORATION DE LA MER
34B STRANDVEJ, HELLERUP–DANEMARK

1832

RAPPORTS
ET
PROCÈS-VERBAUX DES RÉUNIONS

VOLUME XC

SIZE-LIMITS FOR FISH
AND REGULATIONS OF THE MESHES OF FISHING NETS.

REPORTS OF THE PROCEEDINGS OF THE SPECIAL BIOLOGICAL MEETING
HELD ON JUNE 4TH AND 8TH, 1934, AT COPENHAGEN.

EN COMMISSION CHEZ
ANDR. FRED. HØST & FILS
COPENHAGUE

Prix: Kr. 3.00

1600. VII. 34.

Juillet, 1934.

IMPRIMERIE A/S L. IHRICH

CONTENTS

		Page
	Introductory Note, by Mr. Henry G. Maurice	v.
	Proceedings at the Special Biological Meeting, 1. Sitting	vii.
	Proceedings at the Special Biological Meeting, 2. Sitting	xi.
	Conclusions, English version	xii.
	— French version	xiii.
	— German version	xiv.
I.	Size Limits and Mesh Regulations for Sea Fish, by E. S. Russell, London	1.
	Appendix A: Summary of existing Regulations (1933) regarding Size Limits and Mesh Restrictions for Fish taken in the Sea or in Brackish Water (Revised to May 1934)	6.
	Appendix B: Report on the Result of Experiments with Savings Gear, by F. M. Davis, Lowestoft	14.
	Appendix C: A Mesh Experiment Indicating that Small Fish Escape while the Trawl is being towed, by F. M. Davis, Lowestoft	22.
	Appendix D: Preliminary Note on a Commercial Mesh Experiment, by F. M. Davis, Lowestoft	27.
II.	Über ein Mindestmass für die Seezunge der Nordsee, von A. Bückmann, Helgoland	33.
III.	Some Remarks on Mesh Width and its Influence on Young Fish, (with Addendum), by Capt. Thor Iversen, Bergen	39.
IV.	Contribution to an Investigation into the most profitable Size-Limit for Plaice in the North Sea, by Aage J. C. Jensen, Copenhagen	45.
V.	Scottish Seine Net Investigations, by R. S. Clark, Aberdeen	49.
VI.	Experiments with Trawls having Different Meshes in the Cod-End, by K. A. Andersson, Stockholm	59.

Introductory Note.

THE REPORT which follows may be said to mark the conclusion of a stage in the history of the work of the International Council for the Exploration of the Sea. The work of the Council, interrupted only by the Great War, covers a period of 32 years. Its principal function has been, from the beginning, to acquire such knowledge of the life histories of food fishes that it might be able, at need, to give to the Governments represented on it reliable information on this subject, and advice as to the means by which true economy of fishing could best be secured in the waters which their fishermen fish in common. Its task has been difficult, because, in the nature of things, fish living in the open sea cannot be kept under continuous observation. It was, therefore, necessary to evolve a special technique for the study of fishes and of the medium in which they live, the physical changes of which at different periods and in different circumstances play so important a part in their life histories.

During the lifetime of the Council, and largely through its influence, the comparatively young science of Marine Biology has made great strides, but it is still a young science, and there is still much to be learned. To many the progress made has seemed to be slow, but those who realise the difficulties under which marine investigations are carried out recognise that it has in fact been rapid. And now the Council has reached the point at which it can with confidence make certain definite recommendations to the Governments, with a view to the maintenance of an adequate stock of food fishes in the sea and the most economical use of that stock.

It need hardly be said that the occasion for such advice would not have arisen unless there were evidence not merely of wasteful fishing but of fishing so wasteful that it was beginning to have a detrimental effect upon the stock. Fishing has, especially since the war, increased in intensity, and has been carried out by means of increasingly efficient ships and fishing gear. One result of this has been the destruction of increasingly large numbers of fish so small that they are either unmarketable or are marketable only at prices which are barely, if at all, remunerative. These facts are clearly proved by

statistics, and by the results of investigations at sea carried out in accordance with agreed co-operative programmes by naturalists of the various countries which support the Council. The Council has, accordingly, recommended, as a first step, the enforcement by international agreement of regulations governing both the sizes at which fish may be sold and the measurements of the meshes which may be used in fishing. Its recommendations as to mesh are based on the results of experiments to test the selective effect of different meshes in relation to different fishes and fisheries. They are made as a minimum, and do not preclude the adoption of a larger mesh as circumstances and experience may dictate.

The proposed regulations as to size limits for fish are designed, in the case of round fish, to reinforce the mesh regulations by removing any inducement to evade them. In the case of flat fishes, especially plaice, it is hoped that the size limits may discourage fishing on grounds where under-sized flat fish are the predominant part of the population, no practical mesh having yet been designed which will release flat fishes of the sizes which ought to be spared without also releasing round fishes which it is reasonable to take.

The Council's recommendations as a whole are widely based on accumulated knowledge of the life histories of the food fishes.

June 19th, 1934.

Henry G. Maurice.

PROCEEDINGS

at

The Special Biological Meeting.

1st Sitting.

Chairman: Mr. *Henry G. Maurice.*

The meeting was held in Copenhagen on June 4th, 1934, at 2.30 p. m.

Present: Delegates and Experts from the following countries: Allemagne, Belgique, Danemark, Finlande, France, Grande Bretagne, Norvège, Pays-Bas, Pologne, Portugal et Suède.

The Chairman opened the meeting and called upon Dr. E. S. Russell.

Dr. Russell presented his report which had been distributed with 4 appendices some months ago (see full report on page 1), and summarized its contents, drawing attention especially to the various existing size limits and other regulations. He then reported such changes in the regulations as had taken place since the present report had been printed, drawing attention to the fact that the summary would be amended accordingly before the final issue of the report was published.

After discussing briefly the principles of mesh regulation and protection through size limits Dr. Russell proposed the general adoption of regulations similar to the British.

Dr. R. S. Clark then read a report on various mesh experiments with the Whitefish seine made by Scottish investigators. The paper is printed in full as Appendix V to this report.

The Chairman suggested that members might like to discuss the foregoing and subsequent papers immediately after each had been read, and while they were fresh in the minds of everybody. The method preferred, however, was that the representatives of the different countries should be called upon in alphabetical order to give their commentaries and further relevant information. This method was accordingly adopted as a general principle, and the following discussion ensued:—

Allemagne.

As preparations for showing lantern slides were not quite ready, Dr. Bückmann asked permission to speak later, and Belgium was therefore called upon.

Belgique.

Mr. H. Baels expose que la Belgique appelle avec enthousiasme une règlementation en vue de la protection du poisson, mais elle désire que cette règlementation soit générale et mise en vigueur avec ponctualité partout.

La position géographique de la Belgique est telle que la règlementation dans ce pays seulement aurait bien peu de signification; son littoral comprend à peine 80 kilomètres.

C'est pour cette raison que les restrictions apportées avant 1928 et portant sur les dimensions de diverses variétés ont dû être levées. L'orateur lui-même, en qualité de ministre de l'agriculture a pris l'arrêté limitant les *size limits* aux turbots, aux barbues (25 cm.) et aux soles (15 cm.).

Quant aux mailles des filets il n'existe aucune règlementation mais la Belgique est disposée à considérer avec bienveillance une législation similaire à celle de la Grande Bretagne. En fait les chaluts en usage en haute mer présentent des dimensions de mailles dépassant même les dimensions prévues par l'acte de 1933 décrété par la Grande Bretagne.

Au début de cette discussion il importe d'en définir la nature et la portée. Il y a corrélation étroite entre les *size limits* des poissons et les *size limits* des mailles des filets. Il servirait à peu de chose de se montrer sévère quant au débarquement de petits poissons si les filets à mailles trop réduites sont appelés à les tuer.

Mais une affirmation exprimée par les délégués français rend l'aspect du problème plutôt troublant.

Le Commandant Beaugé a contesté, je crois, l'efficacité de la réduction des mailles, la pression des gros poissons ayant pour effet de tuer les petits.

Et puis les délégués français déclarent expressement que les filets crevettiers sont des engins essentiellement destructeurs. Si telle était la réalité que le petit poisson plat et que les oeufs se trouvent détruits dans une proportion de 90 % par les filets aux mailles très serrées employés par la pêche à la crevette, il s'en suivrait que la législation devant s'appliquer à la haute mer serait sans résultat pratique.

Je ne sais si leur affirmation est exacte et je fais appel aux hommes de science ici présents pour nous éclairer à cet égard. Il est préférable que nous ayons des vues bien précises à cet égard. De toute façon l'on ne pourrait songer à éliminer la pêche à la crevette, qui est précieuse et de grand rendement pour mon pays.

Ceci dit, je tiens à répéter que le gouvernement belge serait disposé à suivre la généralité des autres pays dans une politique de protection du petit poisson. Dans une récente réunion du Conseil supérieur de la pêche l'on avait préconisé la taille de 21 cm. pour la plie.

M. le Commandant L. Beaugé dit que la remarque qu'il a faite concerne deux observations, relatives d'une part au poisson et d'autre part au filet. A Terre-Neuve, pour la pêche à la morue, on emploie des mailles de 8 cm., et 10 cm. est même demandé; les pêcheurs se tiennent donc largement dans les limites qu'on veut prescrire. On constate que même à 8 cm. les petits poissons sont morts quand ils montent à la surface. En ce qui regarde le stock du poisson pêché, les pêcheurs français vendent le poisson salé, conséquemment ils veulent pêcher les plus grands poissons possible.

M. le Dr. Ed. le Danois ajoute qu'à Terre-Neuve, à la pêche à la morue, les filets sont trainés pendant long temps, plus de 6 heures parfois, c'est pourquoi les petits poissons meurent; il insiste sur le fait qu'il est très difficile de traiter la question en général, car la pêche n'est pas la même dans les différents endroits.

Allemagne.

Herr Dr. C. Heinrici führt aus: es empfielt sich die beiden zur Diskussion stehenden Fragen, die Maschenweite und die Einführung von Mindestmassen, getrennt zu behandeln. Von der Einführung von Mindestmaschenweiten kann man sich Erfolge in der Hauptsache nur für die Schonung von Rundfischen versprechen, worüber Dr. Bückmann noch genauere Ausführungen machen wird, weniger für die Plattfische. Deutscherseits wird es befürwortet, Mindestweiten nach dem Vorgang Englands einzuführen. Die deutschen Fischer benutzen schon jetzt überwiegend Maschen, die noch weiter sind, und es wäre sehr erwünscht, wenn auch die anderen Länder zu diesen übergingen. Auf dem Gebiet der Mindestmasse hat Deutschland vor kurzem ein Mindestmass von 24 cm. für die Scholle in der Nordsee eingeführt. Bei der Diskussion über Mindestmasse muss man sich darüber klar sein, dass man nicht anstreben kann, die gleichen Masse für alle Küstenstriche und alle Gewässer einzuführen, insbesonders empfiehlt es sich, die Nordsee und Ostsee unter diesem Gesichtswinkel getrennt zu behandeln.

A French summary of these remarks was given by Dr. le Danois.

Dr. A. Bückmann summarizing his observations on the selective action of trawls of different cod-end mesh, stated that considerable proportions of undersized plaice are retained even by larger mesh than those prescribed by British regulations, so that for this species size-limits could not be dispensed with. In addition he referred to a paper on the sole fishery given in full as Appendix II to this report.

Danemark.

Dr. H. Blegvad drew attention to Appendix A (see page 7) showing the size-limit regulations now in force in Denmark. He considered such regulations very good, and he was of opinion that regulations concerning mesh were of less importance — so far as Denmark is concerned — inasmuch as experience has proved to the fishermen that it does not pay to catch the small fish when there is no possibility of selling them, and thus the size of mesh will be regulated voluntarily. For several years scientists had emphasized the necessity of raising the size-limits for plaice, cod, and haddock; the fishermen had been very much against such an increase, but had been induced to accept by the import-restrictions enforced in other countries. Now they were so satisfied with the new limits that he thought still higher limits would follow at their own request. If a limited export only is allowed, it pays better to export the big and valuable fish.

Dr. Aage J. C. Jensen read the paper printed as Appendix IV to this report.

Finlande.

No comment was offered by the Delegates when called upon.

France.

M. Lecourbe dit que son Gouvernement suit avec grand intérêt la discussion sur la taille marchande et sur la grandeur des mailles des filets, mais il n'a pris encore aucune décision. En effet, tout en reconnaissant l'importance de ces questions, au point de vue de la conservation des espèces, le Ministre de la Marine Marchande doit tenir compte des difficultés de la pêche du moment où elle traverse une crise pénible. Il déclare qu'il a reçu des instructions pour ne prendre aucun engagement sur des mesures restrictives si elles ne sont pas adoptées par les autres pays.

En tout cas il considère qu'il est difficile, si non impossible, de fixer des tailles minima différentes pour les diverses parties du littoral, car s'il en était autrement la surveillance des marchés serait inopérante, et la fraude serait facilitée.

Il recommande la généralisation des tailles et se déclare opposé à une règlementation qui varierait suivant les diverses parties du littoral.

Sous ces réserves il déclare qu'il va demander à M. le Danois d'exposer le point de vue

scientifique, et à M. de Laurens-Castelet le sentiment des armateurs à la pêche hauturière.

Le Président désire que l'on discute la question du point de vue scientifique et que les Gouvernements soient priés d'étudier comment on peut réaliser ce que les savants considèrent comme désirable. Si on examine la question du point de vue administratif ou économique on n'arrivera jamais au but.

Dr. le Danois se rallie à l'opinion du Président. L'Office des Pêches Maritimes représente un organisme scientifique; il est arrivé à un certain nombre de conclusions et espère faire triompher les mesures de protection des poissons (tailles minima et augmentation des mailles). Les précédentes communications ont surtout visé la pêche de la plie en Mer du Nord mais ce n'est qu'une partie du problème. La question du poisson rond est au moins aussi importante. Il ajoute qu'on constate de plus en plus que la plus grande dévastation est faite par les pêcheurs littoraux avec les chaluts à crevettes qui détruisent une quantité formidable de petits poissons. On ne peut laisser cette question de côté et il importe que l'on impose les mêmes mesures de mailles à tous les gens de pêche, ce qui n'est pas le point de vue adopté par la Grande Bretagne.

M. de Laurens-Castelet qui représente les armateurs de France et leur opinion, craint qu'il soit inutile de règlementer la pêche en haute mer qui est peu destructive, si on ne règlemente pas la pêche littorale qui détruit 90 % tandis que la pêche aux chaluts de haute mer ne détruise que 10 %. Il semble que la première chose à obtenir est une règlementation de la pêche côtière avant de porter des restrictions à la pêche de haute mer. La règlementation des mailles est le meilleur moyen de limiter la taille des poissons sur les marchés. La règlementation de la taille des poissons est moins indiquée car il se peut que même à grosses mailles on prenne de petits poissons qu'il est inutile de rejeter à la mer puisqu'ils sont déjà morts.

The Chairman explained that the main reason why Great Britain did not legislate for the coastal fishery was the fact that this fishery has its own district committees who have powers of making bye-laws.

Such size limits, however, as were imposed by Order made under the Act of 1933 were of general application. These Orders forbid the sale of certain fishes below certain size limits, and it would be administratively impossible to enforce in the markets different size limits according to the areas in which the fish were taken. The main object of the size limits was to reinforce the mesh regulations. As regards flat fish, however, especially plaice, it was hoped that they would discourage fishing on grounds where there were normally large concentrations of the young of these fishes. One could not keep every ship under inspection at sea, but by preventing the sale of undersized fish one could remove from fishermen the temptation to avoid the mesh regulation when at sea. He wished to remind the meeting, however, that although naturally they would not wish to ignore the practical issues, the Council was chiefly concerned as a scientific body to recommend what on scientific grounds appeared to be desirable, and it was for the Governments subsequently to consider to what extent effect could be given to those recommendations in practice.

Dr. Russell stated that the question of destruction of small fish by the shrimping industry was not so important in Great Britain as in some other countries. It might be true that in certain areas a big destruction of individuals took place, but taking the actual *weight* destroyed, the amount destroyed in the open sea, he thought, was much greater. Besides, as his own and Dr. Bückmann's investigations showed, the destruction of fish at a very early stage was not so prejudicial to the stock as their destruction later on.

M. le professeur G. Gilson dit que l'industrie de la pêche crevettière, très importante en Belgique, n'acceptera jamais aucune limitation des mailles qui entraînerait sa suppression totale. Il demande, en outre, où l'on pourrait placer la limite entre la haute mer et la zone littorale crevettière, et propose l'établissement d'une *zone intermédiaire* dans laquelle serait appliquée une limite de la grandeur des mailles moins élevées que dans la haute mer, tandis que dans la zone littorale la taille minima seule protégerait le jeune poisson. La largeur de cette zone devrait être règlée par chaque pays suivant les conditions physiques et biologiques de la côte. Il s'agit de sauver d'une suppression complète une pêcherie exercée par des navires de grandeur moyenne ne passant pas plus de 3 jours en mer.

Norvège.

Mr. O. Sund read a paper by Captain Thor Iversen which is printed in full as Appendix III (Addendum) to this report.

Professor Johan Hjort said that he appreciated the point of view expressed by M. de Laurens-Castelet, but drew attention to the different conditions prevailing for the different kinds of fish; in the case of haddock and cod the big fish were often caught near the shore and the small ones in the open sea; thus in the Barents Sea the trawlers destroyed enormous quantities of small fish. He proposed that the different Area Committees should take up the question and discuss it in their Committees, reporting the results at a later sitting when the Biological Scientific Meeting would be able to arrive at a reasoned conclusion.

Pays Bas.

Dr. J. J. Tesch stated that similar conditions as in Belgium prevailed in the Netherlands, their regulations being far behind those of Germany and Great Britain. The small plaice were used by the fish meal factories, but restrictive measures for protecting plaice were being considered.

Pologne.

Professor M. Siedlecki said that the problems in Poland were not to be compared to those in the other countries, but still the coast gave a good example of special conditions. The size-limits for plaice, for instance, were extremely low, as it appeared from Dr. Russell's statement, but the geographical races in the Eastern Baltic were smaller than elsewhere, large fish not occurring in these waters.

In addition to the size-limits and mesh regulations dealt with in Dr. Russell's report he said that fishing in a depth of less than 20 m. was prohibited, and this measure had given satisfactory results for the protection of young fishes.

Portugal.

Dr. A. Ramalho informed the meeting that some restrictive measures applicable to trawling off the Portuguese coast were at present under consideration, among others one prohibiting trawling inside the 6 (six) mile limit and in depths less than 60 m. Consideration was also being given to the minimum size of mesh to be allowed in trawling nets more or less comparable to those lately enforced by the legislation of some countries. Size limits were also being studied, but there was a very marked difference between the species caught by more northern trawl-fishing and those which are more common in the regions frequented by Portuguese trawlers.

Suède.

Dr. K. A. Andersson said that Dr. Russell had dealt with the Swedish size-limits in his report. He gave the results of some mesh experiments carried out with trawls; the catches differed widely, he said, but many small haddock were saved. In his opinion the difficulties in the herring trawl fishery were great, but he hoped it would be possible to enforce some mesh regulations, especially since the fishermen themselves showed a greater interest in these regulations. The paper is printed in full as Appendix VI to this report. He supported Professor Hjort's proposal.

In answer to a request from the Chair Mr. F. M. Davis gave some concluding remarks on mesh experiments. He emphasized the necessity for carrying out all mesh experiments by means of parallel hauls on similar vessels, the only method which ensured comparable results. He wished one more point to be considered; how the nets should be measured: by knots per yard, internal measurements or gauge; he stated that his colleague, Mr. Buchanan-Wollaston, had produced a perfectly satisfactory gauge. Finally he said that the table on page 19 of Appendix B had to be modified in the light of further experiments; all its figures should be raised considerably.

The Chairman in concluding the meeting said that he had hoped that the discussion might have lead to some provisional conclusions for further consideration by the Area Committees. He understood that the meeting concurred in the view that something ought to be done for the protection of undersized fish, but they had not precisely stated what this should be. It would be no good to carry on the same discussion again in the Committees. He suggested that the Committees be asked to consider, in the light of the information at the disposal of their members, the introduction of measures at least not less than those enforced by Great Britain. He added that the British regulations had been accepted with great hesitation by the fishing industry but that they were, generally speaking, now so satisfied with them that they wished, in some respects, to go further.

M. H. Baels called attention to a point overlooked, as he thought, because of the difficulty of languages, namely the French statement that the shrimp nets were responsible for the destruction of small fish. He thought that if this was an established fact it was useless to continue the discussion.

Dr. le Danois asked the Meeting to formulate a question to be put to the Committees; he suggested a limitation of depth for the fishery in each area.

M. Baels suggested an enquiry into the destructiveness of the shrimp net.

The following Resolution was then adopted:—

The Special Biological Meeting asks the Area Committees to consider, in the light of the information at the disposal of their members,

1) (a) whether they can recommend the application of size-limits and mesh regulations not less restrictive than those enforced by Great Britain, or alternately

(b) whether they can recommend measures either more or less restrictive, and

(c) in the latter case precisely what size limits for fish and regulations for mesh they recommend.

2) Whether the use of the shrimp trawl is so destructive of small flat fish that its use ought to be prohibited, as has been suggested, and

3) Whether certain methods of fishing ought to be prevented in waters of less than certain depths. If so what methods and at what depths.

Second Sitting.

On June 8th, 1934, at 3.00 p. m.

The President proposed Dr. E. J. Allen as Chairman for this sitting. Dr. Allen was unanimously elected and opened the meeting by informing the members present that a draft statement or report had been prepared by the President for discussion. He intended to read this, and on reaching the conclusions to suggest that they should be read point by point and accepted or discussed singly.

The Chairman then read the following report, which is here published in the form finally adopted, i. e., the alterations made during the discussion at the meeting have been incorporated in the final draft, which was unanimously adopted by the meeting.

Statement.

The Council has reviewed the measures at present taken by the participating countries for the protection of the stock of food fishes in the seas adjacent to Europe outside the Mediterranean as summarized in a report prepared by Dr. E. S. Russell. In its review it has taken into account the experience gained, through prolonged investigations, of the many factors governing the life of young fishes from the egg to maturity and experiments carried out to test methods of preventing small fishes of little or no market value from being destroyed. The method adopted in most countries, where any measures of protection have been introduced, has taken the form of the imposition of size limits for fish, and, as a rule, for flat fish only. In Great Britain also a certain measure of protection has been secured by regulating the size of the mesh of nets and by prohibiting the sale of certain flat fishes and, among round fishes, of haddock, whiting and hake below certain size limits.

As a result of a preliminary study of the subject in general terms at a special meeting, at which the information summarized in Dr. Russell's report was amplified by personal communications, the following questions were formulated for examination by the regional committees, in the light of their information of the special conditions affecting the regions embraced in their investigations, namely:—

1) (a) whether they can recommend the application of size limits and mesh regulations not less restrictive than those enforced by Great Britain, or alternately

(b) whether they can recommend measures either more or less restrictive, and

(c) in the latter case precisely what size limits for fish and regulations for mesh they recommend.

2) whether the use of the shrimp trawl is so destructive of small flat fish that its use ought to be prohibited, as has been suggested, and

3) whether certain methods of fishing ought to be prevented in waters of less than certain depths. If so what methods and at what depths.

The following replies were received from the regional Committees:—

North Eastern Area Committee.

1. In the North Eastern Area all trawling is forbidden in territorial waters in depths less than 60 metres. As shrimp trawling in Norway is restricted to greater depths than the said limit no conflict exists for the North Eastern Area between the interests of the shrimp fishery and the conservation of the fry of commercially valuable fish.

2. The North Eastern Area Committee considers the question of saving cod and haddock below the commercial sizes as the most important one, and recommends the adoption of a size limit of 30 cm. The Committee recommends that this minimum size be enforced by all countries in regard to fish caught within the North Eastern Area.

3. In order to attain this desired end — the saving of all cod and haddock below 30 cm. — in view of the present experimental data it is considered that the trawl cod-end mesh should be 10 cm. internal measurement.

4. The Committee wishes to recommend continued experiments with trawls of different meshes and to emphasize the necessity of continuous investigation of the commercial catches regarding the distribution of sizes, as caught, of cod and haddock and asks the Council to urge collaboration in this task on the Governments interested in the conservation of the fish stocks within the area.

North Western Area Committee.

The Committee considered the questions referred to it by the Special Biological Meeting. The Committee agreed that application of size-limits and mesh regulations not less restrictive than those enforced by Great Britain should be supported (1 a). As shrimp trawls or other finemesh implements highly destructive to small fish, are practically not used in this area, Points 2 and 3 were not considered by the Committee.

Northern and Southern North Sea Committees.

1. The Southern North Sea Committee considers that for deep sea fishing within its area the mesh regulations prescribing minimum sizes of mesh at least no smaller than those stipulated in the orders under the British Sea Fisheries Act 1933 are to be recommended.

It is further considered that minimum sizes at least corresponding to those of the orders under the British Sea Fisheries Act are to be recommended. It is emphasized that as far as broad flat fish such as Plaice are concerned, mesh regulations alone will not guarantee protection of undersized fish.

2. The Committee considers that in addition to the considerable information gained further researches are to be recommended regarding the deleterious effect of destruction of undersized fish by the coastal fisheries. It is recommended that in places where this effect has been proved to be prejudicial and the minimum sizes recommended above will not meet the case, further protective measures be introduced.

3. It is considered that, owing to the considerable variation of geographical and biological conditions of the coastal areas the demarcation of inshore fishing from deep sea fishing and consideration of regulations regarding inshore fishing should be left to the several countries.

Combined Baltic and Transition Area Committees.

The Committees are of the opinion that the size limits for fish and the minimum sizes of meshes now in force in Great Britain constitute the lowest limits advisable for protection of demersal fishes, the inner part of the Baltic excepted.

In the Baltic and the Transition Area international size limits are already in force for plaice and flounder. The question of an international size limit for cod is under consideration.

The size of mesh in the cod-ends used in the Baltic for trawling demersal fish are larger than those in force in Great Britain.

The fishing for *Pandalus borealis* takes place only in deeper water and is thus not destructive of young fishes.

With unimportant exceptions trawling in the territorial waters of both areas is prohibited by Denmark, Germany, Norway, Poland and Sweden. Moreover in some cases trawling is forbidden in water of less than 20 m. depth. No trawling is carried out by Finland.

The two Committees are of the opinion that, in principle, size limits and mesh regulations are of value as protective measures. It is desirable that the practical details of their application should be more closely treated in a joint meeting of experts from all countries concerned.

From these replies, coupled with the information available, the Council draws the following conclusions:—

Conclusions.

(Authentic Text.)

1) It is important, for the maintenance of the stock, that measures to prevent waste be taken by all countries fishing in the waters included in the Council's investigations.

2) The most useful measure of control will take the form of prevention, as far as possible, of the capture of young fish below the size at which they can be sold at a remunerative price for the food of man.

3) It has been shown that, in the case of the trawl net and Danish seine, appreciable protection of young round-fishes can be secured by regulating the size of mesh of the bag or cod-end. This method needs to be further elaborated, but enough experience has been gained to justify a minimum size of mesh which should be required in the construction of the bag or cod-end employed in the open sea.

4) The minimum mesh which the Council recommends is that already enforced by the regulations of the British Government, which, they are satisfied, will ensure the release of an appreciable quantity of undersized fish now captured and retained.

5) No way at present practicable of regulating the mesh has yet been devised which would secure the release of flat-fishes up to the sizes at which they ought to be protected and would not release marketable round fish.

6) It is, therefore, desirable that size-limits should be imposed for flat-fishes in order to discourage fishing on grounds where small flat-fishes form the greater part of the population.

7) The imposition of size-limits is also desirable for round-fishes, in order to re-inforce the mesh-regulations, and to remove the temptation for fishermen to evade these regulations when at sea.

8) The foregoing proposals as to mesh are intended to apply in principle and so far as is practicable to all modes of fishing for demersal fishes both in the open sea and in coastal waters.

9) But they are not intended to apply to fishing for herring, sprat, pilchard and mackerel.

10) Certain fisheries, especially those for prawns and shrimps, involve the use of nets of small mesh. These fisheries lead, in certain areas and at certain times of the year, to the destruction of large numbers of fish in very early stages. Accordingly, where these nets are shown to be unduly destructive they should be regulated so as to reduce the destruction. The Council is not prepared at present to indicate what form such regulations should take; but suggests that the question should be carefully studied and regulations introduced by each country in the light of local conditions.

11) While the Council recommends the adoption

by all countries, as a minimum, of the mesh-regulations in force in Great Britain, it takes note of the proposal of the North Eastern Area Committee that a larger mesh should be required for fishing in that region, such as is at present in use by German trawlers in Barents Sea and by the French at Newfoundland. The Council supports this recommendation in principle, and suggests that it be carefully considered by all countries fishing in those waters, and that effect be given to it as far as practicable.

12) The Council recommends the adoption by all countries, as soon as possible, of size-limits not less than those required by British regulations. It is of the opinion that experience will show that some of these might be usefully extended, and that size-limits might also be introduced with advantage for other fishes, especially cod. It wishes, however, to emphasize the fact that the chief thing to aim at is the prevention of the *capture* of undersized fish, and that accordingly the regulation of fishing should take first place.

13) The Council recognizes the difficulty of enforcing different measures of protection for different areas and different fisheries; but it considers that, when the question of increasing the minimum measures now proposed arises, this question will have to be faced and solved.

14) The Council is convinced that with a view to the ultimate solution of these questions, it is essential that each Government should arrange for further observations to be carried out by competent observers not only in research-vessels, but also in commercial fishing-vessels, and in the fish-markets.

15) The Council recognizes that the conditions of the Baltic Sea and the Belts present characteristics which differentiate the fishing of those waters somewhat sharply from the other waters coming within the purview of its investigations. Already international arrangements have been made for the regulation of the fisheries of this region and the Council does not wish as regards these fisheries to recommend more than that the principle of regulation by mesh and by size-limits for fish should be applied with due regard to the special conditions of the area.

The foregoing statement and conclusions were unanimously adopted by the meeting for recommendation to the Council.

The meeting concluded at 5.30 p.m.

A French and a German version of the Conclusions above are attached hereto, but it was generally agreed that the English version, which was accepted by the meeting, should be the authentic text. As such, it was accepted and adopted, with slight amendments which have been inserted above, by the Council at its final sitting on Saturday the 9th (cf. Vol. LXXXIX, part I.).

Conclusions.

(Texte française.)

1) En vue d'assurer de façon appropriée la conservation des espèces de poissons comestibles, il importe que des mesures soient prises par tous les pays se livrant à la pêche dans les eaux comprises dans la zone d'études du Conseil International, afin d'éviter tout abus.

2) Les mesures de contrôle les plus utiles qui peuvent être édictées dans ce but doivent autant que possible empêcher la capture des jeunes poissons qui n'ont pas encore atteint les dimensions convenables pour être vendues à un prix remunérateur pour l'alimentation humaine.

3) Il a été démontré qu'en ce qui concerne le chalut et la senne danoise, une protection suffisante des jeunes poissons ronds peut être obtenue en règlementant la dimension des mailles du fond ou du sac de ces engins. Bien que cette méthode doive encore faire l'objet de recherches ultérieures, l'expérience déjà acquise permet de justifier la proposition tendant à prescrire une dimension minima des mailles des parties sus-indiquées des filets en cause, utilisés pour la pêche en mer libre.

4) La taille minima que le Conseil préconise est celle déjà imposée par les règlements du Gouvernement britannique et qui d'après les expériences déjà faites permet à une importante quantité de poissons de trop petite dimension de s'échapper alors qu'ils seraient retenus par les filets ordinairement utilisés jusqu'ici.

5) En ce qui concerne les poissons plats, aucune règlementation de la dimension des mailles n'a encore été trouvée, qui permette aux poissons de ce genre de s'échapper lorsqu'ils n'ont pas les dimensions où leur protection doit cesser sans permettre aussi aux poissons ronds de bonne taille de s'échapper.

6) En conséquence, la fixation d'une taille marchande minima des poissons plats devrait être

étudié, en vue de détourner les pêcheurs des fonds sur lesquels les petits poissons de ce genre représentent la majorité de la faune ichthyologique.

7) La fixation d'une taille marchande minima pour les poissons ronds est également utile pour renforcer les dispositions prises en ce qui concerne les dimensions des mailles, de façon à éviter que les pêcheurs ne cherchent à restreindre celles-ci quand ils sont au large.

8) Les mesures proposées ci-dessus concernant la dimension des mailles des filets appliquent en principe et dans les mesures des possibilités à tous genres de pêche des poissons de fond, aussi bien en mer libre que dans les eaux côtières.

9) Ces propositions ne s'étendent pas aux filets employés pour la pêche du hareng, de la sardine et du maquereau.

10) Certaines pêches et notamment celle des crevettes grises et roses emploie nécessairement l'usage de filets à petites mailles. L'usage de ces engins dans certaines régions et à certaines époques de l'année, entraîne la destruction d'un grand nombre de poissons de fond encore aux premiers stades de leur développement. En conséquence, ces engins doivent être règlementés pour réduire leur puissance de destruction, partout où il est prouvé qu'ils sont particulièrement nocifs. Le Conseil n'est pas encore en état de préciser sous quelle forme devraient être prises les mesures nécessaires, mais il insiste pour que la question soit sérieusement mise à l'étude et que des dispositions règlementaires soient prises dans chaque pays en tenant compte des conditions locales.

11) Tout en recommandant à tous les pays d'adopter comme un minimum, les règlements britanniques en vigueur sur la dimension des mailles de filets, le Conseil prend acte de la proposition du Comité du secteur Nord Est de l'Atlantique tendant à l'adoption d'une dimension de maille plus grande pour la pêche dans cette region. Il approuve le principe de cette recommandation et insiste auprès des différentes nations pêchant dans ces eaux pour que sa réalisation soit étudiée serieusement et si possible suivie d'effet.

12) Le Conseil recommande que soit au moins adopté par tous les pays et dans le plus bref délai possible le règlement britannique sur les tailles marchandes des poissons. Il pense que l'expérience démontrera l'utilité d'augmenter certaines d'entre elles et d'étendre des mesures analogues à d'autres espèces de poissons et notamment à la morue. Il insiste toutefois sur le fait qu'il convient avant tout d'empêcher la capture des poissons de taille insuffisante et par suite de faire passer en premier lieu la règlementation des engins de pêche.

13) Tout en reconnaissant la difficulté de renforcer des mesures de protection pour certaines pêches et dans certaines regions, le Conseil estime que si la question d'un accroissement des tailles minima est posée, elle devra être étudiée et resolue.

14) En vue de la mise au point définitive de ces questions et pour arriver à un contrôle rationel des règlements internationaux concernant la pêche, le Conseil est convaincu de la nécessité de faire effectuer des enquêtes par les autorités compétentes de chaque pays à la fois à bord des bateaux de pêches et sur les marchés de poissons.

15) Le Conseil reconnait que les conditions de pêche dans la mer Baltique et dans les détroits offrent des caractéristiques qui les différencient des autres zones. Déjà des accords internationaux ont été passés pour la règlementation de la pêche dans cette region et le Conseil ne croit pas en ce qui concerne les tailles minima et la dimension des mailles avoir à proposer une autre règlementation que celle actuellement en vigueur.

Leitsätze.

(Texte allemagne.)

Es erscheint notwendig zur Erhaltung des Fischbestandes Schonmassnahmen zu ergreifen in allen Ländern, welche in den Gewässern fischen, auf die sich die Untersuchungen der Internationalen Meeresforschung beziehen.

2) Die zweckmässigste Schonmassnahme besteht darin, soweit wie möglich dem Fang von jungen Fischen vorzubeugen, die die Grösse noch nicht erreicht haben, bei der sie zur menschlichen Ernährung geeignet und zu angemessenem Preis zu verwerten sind.

3) Es hat sich ergeben, dass beim Schleppnetz und der dänischen Wade ein erheblicher Schutz junger Rundfische durch Regelung der Maschenweite des Netzsackes oder des Steertes erreicht werden kann. Diese Methode muss noch weiter ausgearbeitet werden, aber die bisherigen Erfahrungen rechtfertigen es bereits, gewisse Mindestmaschenweiten für den Netzsack oder den Steert der Netze festzusetzen, die auf offener See verwendet werden.

4) Als Mindestmaschenweiten empfiehlt die Meeresforschung die durch die britische Regierung vorgeschriebenen festzusetzen. Es ist durch Versuche hinreichend belegt, dass diese das Entkommen beträchtlicher Mengen untermassiger Fische sicherstellen, die von den gegenwärtig in England gebräuchlichen Netzmaschen mitgefangen werden.

5) Ein ausreichender Schutz von untermassigen Plattfischen kann nach den bisherigen Erfahrungen durch Regelung der Maschenweiten ohne Beeinträchtigung des Fanges von marktfähigen Rundfischen nicht erreicht werden.

6) Für Plattfische ist daher die Einführung von Mindestmassen wünschenswert, um das Interesse am Fischen auf solchen Gründen zu nehmen, wo kleine Plattfische den grössten Teil des Fischbestandes bilden.

7) Die Einführung von Mindestmassen ist auch für Rundfische zu empfehlen, um die Wirksamkeit der Vorschriften über die Maschenweiten zu erhöhen und den Anreiz zu ihrer Umgehung auf See zu nehmen.

8) Die vorstehenden Vorschläge über Maschenweiten sollen grundsätzlich und soweit als möglich auf alle Arten des Fanges von Grundfischen Anwendung finden, auf hoher See wie auch in Küstengewässern.

9) Die Vorschläge beziehen sich aber nicht auf den Fang von Heringen, Sardinen, Sprotten und Makrelen.

10) Bei gewissen Fischereien, besonders auf Garneelen, müssen Netze mit engen Maschen verwendet werden. Diese Fischereien bringen in gewissen Gegenden und Jahreszeiten die Vernichtung grosser Mengen von Fischen in den ersten Lebensstadien mit sich. Wo diese Netze zu einer übermässigen Zerstörung führen, sollten Bestimmungen erlassen werden, diese Schädigung zu vermindern. Die Meeresforschung sieht zur Zeit davon ab, bestimmte Massnahmen vorzuschlagen, empfiehlt aber, diese Frage eingehend zu prüfen und in den einzelnen Ländern Massnahmen unter Berücksichtigung der örtlichen Verhältnisse zu treffen.

11) Die Meeresforschung empfiehlt, in allen Ländern mindestens die zur Zeit in Gross-Britannien geltenden Maschenweiten einzuführen. Sie nimmt gleichzeitig Kenntnis von dem Vorschlag des North Eastern Area Committee, in dieser Gegend grössere Maschenweiten zu verwenden, wie dies schon jetzt bei der deutschen Fischerei in der Barents See und der französischen bei Neu-Fundland Brauch ist. Die Meeresforschung tritt diesem Vorschlag grundsätzlich bei und empfiehlt seine Durchführbarkeit sorgfältig in allen Ländern zu prüfen, welche in diesen Wassern fischen und ihm soweit möglich zu entsprechen.

12) Die Meeresforschung empfiehlt, baldmöglichst in allen Ländern mindestens die Mindestmasse für Fische einzuführen, die durch die Britischen Vorschriften gefordert werden. Nach ihrer Meinung wird die Erfahrung zeigen, dass es zweckmässig sein könnte, einige dieser Mindestmasse zu erhöhen und Mindestmasse auch für andere Fische, besonders den Kabeljau einzuführen. Sie möchte dabei aber betonen, dass es in erster Linie darauf ankommt, den *Fang* untermassiger Fische zu verhindern und dass deshalb die Regelung der Art des Fischens an erster Stelle stehen muss.

13) Die Meeresforschung verkennt nicht, dass es schwer ist, verschiedene Schonmassnahmen für verschiedene Gegenden und verschiedene Fischereien einzuführen, sie glaubt aber, dass man diese Schwierigkeiten wird ins Auge fassen und lösen müssen, wenn es sich darum handeln wird, die Mindestmassnahmen, die jetzt vorgeschlagen werden, auszugestalten.

14) Die Meeresforschung hält es von entscheidender Bedeutung für eine endgültige Lösung dieser Fragen, dass jede beteiligte Regierung für fortlaufende Beobachtungen durch Sachverständige auf Forschungs- sowie Fischerei-Fahrzeugen und auf den Fischmärkten Sorge trägt.

15) Die Meeresforschung gibt ihrer Ansicht dahin Ausdruck, dass die Beltsee und die Ostsee gewisse Eigentümlichkeiten zeigen, die die Fischerei in ihnen von der Fischerei in den anderen Gewässern erheblich unterscheiden. Auch bestehen bereits für sie internationale Abmachungen für den Schutz der Fischerei. Die Meeresforschung beschränkt sich für dies Gebiet auf die Empfehlung, auch hier die Grundsätze der Regelung von Maschenweiten und der Einführung von Mindestmassen unter Berücksichtigung der besonderen Verhältnisse dieses Gebietes durchzuführen.

I

SIZE LIMITS AND MESH REGULATIONS FOR SEA FISH.

BY

E. S. RUSSELL,
MINISTRY OF AGRICULTURE AND FISHERIES, LONDON

Introduction.

THERE will be found in Appendix A (p. 7) a summary of the information received from members of the Council as to size limits and mesh regulations in force in 1933.[1]) I have found it impossible, especially in view of the conditions in the Baltic, to draw a hard and fast line between sea fish and fresh water fish, and I have therefore included in this Appendix data relating to anadromous fish and those found in partially salt waters. It is not proposed, however, to discuss in this covering report the regulations relating to such fish; the report will deal only with the more important marine species and principally those taken by the trawl and other bottom fishing gear. For Appendices B, C and D, I am indebted to my colleague, Mr. F. M. Davis, who has given much attention to experiments with fishing gear, and especially to the effect of enlarging the cod-end meshes in the trawl. Appendix D is of special importance, summarising as it does the results of a commercial experiment carried out by England in the autumn of 1933 in which the catching power of the standard cod-end mesh (the minimum imposed by order under the Sea Fishing Industry Act, 1933) was compared with that of a somewhat larger mesh.

The Present Position as regards Size Limits.

It will be seen from an inspection of Appendix A that a considerable difference in practice exists between the various countries in respect of the size-limits imposed. International agreement has so far been achieved only in the Baltic Convention (1929) and the Convention recently entered into by Denmark, Norway and Sweden relating to plaice in the Transition Area. In the following paragraphs the position with respect to the principal species of sea fish is summarised; regulations of local application only are omitted.

[1]) It contains also additions and revisions bringing its information up to date to May, 1934.

1. Plaice.

The main size-limits in force are 27 cm. in Norway and Iceland, 26.0 cm. in Denmark, 24 cm. in Germany (North Sea coast), and 23 cm. in Great Britain, together with those fixed by Convention, namely 25.7 cm. in the Skagerak, Kattegat, Sound and Belts, and 24 cm., 21 cm. and 18 cm. in different sections of the Baltic.

An increase in the western section of the Baltic was mooted at the meeting of the Baltic Committee in 1933 (Rapp. et Proc. Verb., Vol. LXXXV, Pt. 1, p. 38).

2. Dab.

A limit of 25 cm. is in force in Denmark and 23 cm. in the United Kingdom.

A size limit of 18 cm. is in force in Poland.

3. Flounder.

Size limits varying from 22 cm. to 18 cm. in different areas are fixed by the Baltic Convention. There is a 20 cm. limit for the Skagerak imposed by Norway, while Denmark has a general limit of 25 cm.

4. Sole.

A limit of 24.5 cm. in Denmark, and of 23 cm. in the United Kingdom; 15 cm. in Belgium; 13 cm. in Spain.

5. Turbot.

A size limit of 32.5 cm. in Denmark (21 cm. in Bornholm and Christiansö); 25 cm. in Belgium; 18 cm. in Poland.

6. Brill.

29.5 cm. in Denmark; 25 cm. in Belgium.

7. Other Flat Fishes.

A limit of 30 cm. for the Witch in Sweden (Skagerak and Kattegat). A 23 cm. size limit for Witches, Lemon Soles and Megrims has been adopted by Great Britain (Order dated April 11th, 1934).

8. Haddock.

A size limit of 24 cm. is in force in the United Kingdom. The question of imposing a size limit is being considered by Denmark. The export to the United Kingdom of haddock less than 36 cm. is prohibited by Denmark.

9. Cod.

A limit of 31 cm. in Denmark (except in Bornholm and Christiansö); 25 cm. in Norway (Skagerak coast). The extension of this or a higher size limit to the whole coast of Norway is under consideration.

10. Whitting.

A size limit of 24 cm. in Great Britain (Order dated April 11th, 1934).

11. Hake.

A size limit of 33 cm. is in force in the United Kingdom; 13 cm. in Spain.

The Present Position as regards Mesh Regulations.

If we leave out of consideration the regulations applying only to territorial waters, and the restrictions imposed in several countries on the nets used for the capture of specific fish such as salmon, sea trout and eels, we find that the only restriction applying generally to bottom-fishing gear on the high seas is that imposed by the United Kingdom on the cod-end mesh of trawls and seines. This is approximately a 3-inch mesh (for details see p. 10). There is also a minimum mesh of 5.5 cm. for Danish seines imposed in Iceland.

General Considerations and Suggestions.

There are two important points on which, I take it, the Council is agreed — (1) that it is desirable to spare undersized fish, especially those that are approaching a commercially valuable size, and (2) that, at least so far as round fish are concerned, it is practicable to limit the capture of under-sized fish by an appropriate increase in the mesh of the nets used. Point (1) was very fully discussed at the Biological Meeting in 1932 (Rapp. et Proc. Verb. LXXX) and nothing more need be said about it here. Point (2) has also been debated on many occasions and the principle of mesh regulation (with particular reference to the haddock) was fully accepted by the Biological Meeting of 1932 (see Rapp. et Proc. Verb., Vol. LXXXI, p. 102).

Further evidence as to the efficacy of enlargement of mesh in the cod-end of the trawl is presented in Appendices B, C and D attached to this report.

It may be convenient at this stage to consider the action taken by Great Britain through the passing of the Sea-Fishing Industry Act (1933). Power is taken by this Act to impose size-limits on sea fish and to regulate the mesh and construction of fishing gear. There are several points of administrative interest about this measure. In the first place, no specific limits or mesh regulations are laid down in the Act itself; these are imposed, as conditions warrant, by Orders issued under the authority of the responsible Ministers. The Orders may relate to particular fish and particular types of gear, and a great deal of flexibility is thus attained. In the second place the size-limits imposed by Order relate to *sale* (or possession or exposure for sale) and not to capture or landing. This gets rid of a great deal of trouble in the enforcement of the Orders relating to size-limits. In the third place, territorial waters are excluded from the operation of Orders relating to fishing gear, which might otherwise press hardly upon inshore fishermen.

The size-limits imposed by the Order dated July 29, 1933, on plaice, dabs, soles, haddock and hake, were agreed with representatives of the fishing industry, and were so adjusted as to cut out only the very smallest fish from the markets. They are to be regarded as absolute minima so far as British fishing is concerned, and the probability is that some of them will have to be increased in the future. Further size limits (on whiting, witches, lemon soles and megrims) have recently been imposed.

With regard to the restriction imposed on the cod-end mesh of trawls and seines, this also is to be regarded as a minimal measure. The change effected is not great, and the main result has been to standardise mesh at the level of the best previous practice. Strong evidence is given in Appendix D that a larger mesh (21 rows to the yard in use, or 23 per metre) could be introduced with advantage to the saving of the stock, and without any diminution in the value of the marketable catch. It should be noted that nets used for the capture of herrings and shrimps are expressly excepted from the operation of the Order. In general, the Act has aroused little opposition, and no difficulty has been experienced in its administration.

The success of the British action in introducing mesh regulations, coupled with size-limits, suggests that the time may be opportune to raise the question of international agreement on these two points. In order to give definiteness to the discussion of the mesh question, I would suggest, for the consideration of the members of the Council, that the introduction of a mesh corresponding to that used in the British commercial experiment should be recommended for international acceptance. This recommendation applies in the first instance to trawls (used outside territorial waters), with the exception of those employed for the capture of

herring, for which a smaller minimum should be fixed. I would further suggest that an equivalent mesh be agreed internationally for seine nets. Further investigations on the saving effect of seine meshes may prove to be necessary before such equivalent mesh can be fixed. The introduction of this larger mesh for trawls and seines is under discussion with the fishing industry in Great Britain.

It may be noted here that the Meeting of Cod Experts held in November 1933 has reported in favour of other countries following the British practice in enforcing a minimum mesh for trawls (Rec. 1 of the Meeting)[1]). It was stated at that meeting that German trawlers commonly used a cod-end mesh larger than the present British minimum, particularly in Icelandic waters and in the Barents Sea.

With regard to size limits, the position is much more complex, and it is difficult to offer any hard and fast suggestions. The first point to take into consideration is that the position is different for round fish and for flat fish. By an appropriate increase in mesh a considerable proportion of undersized round fish and soles can escape capture, but so far at least as the deep sea trawl is concerned this is not the case to any important extent with flat fish, for the undersized fish inevitably caught are unlikely to survive in any great numbers even if thrown overboard immediately after capture. They have presumably more chance of survival if taken by light gear like the Danish seine. Size limits for round fish and soles should accordingly be fixed with reference to the catching power of the mesh, where this is limited by law. The function of such size limits is, I taken it, two-fold. They are meant to reinforce the mesh regulation, by taking away any inducement to use a smaller mesh; and they serve also to keep off the markets the smallest fish and thus to maintain or increase the average price. Reference to Fig. 1 in Appendix D will show that the mesh recommended above takes very few haddock under the statutory limit of 24 cm., and the same may be presumed to be true with regard to hake under 33 cm. (see Appendix B, p. 14).

The imposition of a size limit for flat fishes (exclusive of the sole, which ranks as an "escaper" with the round fish rather than the flat) has, in the case of a "sparing" fishery, like that with the Danish seine, the object of preventing the destruction of the undersized fish caught, for not being saleable they have a good chance of being returned to the sea alive. In the case of a "nonsparing" fishery like that with the deepsea trawl, the saving effect of a size limit for flat fishes must be indirect, through discouraging fishing on grounds which carry a high proportion of undersized fish. For both types of fishery, the imposition of a size limit which prevents the sale of the smallest fish has an economic value in tending to keep up the average price.

When we come to consider the matter in more detail we see at once that, as the conditions vary from one country to another, in respect both of the methods of fishing and of the economic demand, it is difficult to suggest any international size limits which would adequately meet the needs of *every* country. For example, Norway finds it useful to impose a 27 cm. limit on plaice, Denmark a limit of 26 cm., Great Britain a limit of 23 cm., while it is doubtful whether Holland and Belgium would at present find practicable even so low a limit as the last named. The Council has itself recommended a size limit of 22.5 cm for the North Sea plaice (Rapp. et Proc. Verb., vol. LXXXV, Pt. 1, p. 16), and this recommendation has been conveyed to the Governments concerned. At the time of writing (January, 1934), only one reply had been received, intimating that the British Government concurred in the recommendation and had already imposed a size limit (23 cm.) on plaice. As things are at the moment, several countries have size limits for plaice exceeding the minimum suggested by the Council, while other countries have none, though the question is being actively considered in several countries.

The position is not so difficult with regard to other fish, particularly round fish and soles, and the possibility of securing international agreement on effective size-limits seems greater.

It is not, I take it, the business of the Council to take into detailed consideration the political and administrative difficulties which may arise in the different countries with regard to the imposition of specific size-limits. Our duty is to decide on scientific grounds what size-limits would at present be desirable, having due regard of course to practical conditions. In order that the discussion may be concentrated on a definite proposal I would suggest that the Council consider recommending the international acceptance of the size-limits at present imposed by Great Britain, namely 23 cm. for plaice, dabs, witches, lemon soles, megrims and soles, 24 cm. for haddock and whiting and 33 cm. for hake.

---

[1]) The Committee expressed its appreciation of the steps already taken by the British Government in enforcing a mesh for trawls and hoped that every country would adhere to the British practice and that in future the mesh might in all countries be increased to the size most useful for the conservation of the stock.

APPENDIX A.

Summary of existing Regulations (1933) regarding Size Limits and Mesh Restrictions for Fish taken in the Sea or in Brackish Water.

(Revised to May, 1934).

1. Belgium.

(a) Size Limits. (Prohibition of landing).

Turbot	25 cm.
Brill	25 cm.
Sole	15 cm.

(b) Mesh Regulations.

None.

2. Denmark.

(a) Size Limits.

Plaice	26.0 cm.,
Iceland	27.0 cm.,

subject to the following modifications —

(1) In those areas of the Limfjord where transplantation of plaice is carried out the size limit is raised to 28.6 cm. in one area, and 30.4 cm. in another, from April 1st to Oct. 15th.

(2) In the Sound, except at Copenhagen and Elsinore, plaice above 21 cm. may be landed for local use.

(3) Size limit for export

(a) from Bornholm	22 cm.
(b) from Esbjerg, June 1st—March 15th	24.5 cm.
Turbot	32.5 cm.

except for turbot landed at Bornholm and Christiansö for use in those islands or for export, when the limit is 21 cm.

Brill	29.5 cm.
Flounder	25 cm.
Dab	25 cm.
Sole	24.5 cm.
Cod	31 cm.

except for cod landed at Bornholm and Christiansö for sale in these islands or for export, when the limit is 29.0 cm.

Eel	34 cm.
Salmon	37 cm.
Sea Trout	37 cm.
Coregonus lavaretus	30 cm.
Coregonus oxyrhynchus	30 cm.
Pike	40 cm.
Lobster	21 cm.

General Notes (1) Undersized fish, except Salmon and Sea Trout, may be landed for bait on the West coast of Jutland between Tversted Beacon and Blaavandshuk.

(2) Higher size limits are in force in certain local areas.

(3) Dabs, Lumpsuckers, Gobies, *Zoarces* and Sprat may not be used for manure or pig-food, and Herring may not be used for manure without the special sanction of the Ministry.

(4) The size limits do not apply in the Faroes.

(5) The export to the United Kingdom is prohibited of:—

1. Whiting, Herring and Mackerel of all sizes.
2. Haddock less than 36 cm. in length.
3. Flounders „ 25 cm. „
4. Dabs „ 27.5 cm. „
5. Plaice „ 27.5 cm. „
6. Cod „ 50.0 cm. „

(b) Mesh Regulations.

No general regulations in force, except for certain nets used for the capture of eels and flounders. A minimum mesh of 5.5 cm. for Danish seines has been imposed at Iceland.

3. Finland.

(a) Size Limits.

Salmon	35 cm.	
Sea Trout	35 cm.	
Lake Trout	20 cm.	
Salvelinus (in Ladoga)	30 cm.	
Thymallus vulgaris	25 cm.	Caught in Gulf of Bothnia and Gulf of Finland.
Coregonus lavaretus	25 cm.	
Abramis brama	30 cm.	
Leuciscus idus	25 cm.	
Lucioperca sandra	35 cm.	

(b) Mesh Regulations.

Nets for Salmon	5.5 cm.	knot to knot.
„ „ Sprat and Smelt	1.0 cm.	„
„ „ Baltic Herring	1.4 cm.	„
„ „ Bream, Pike-Perch and Pike	2.0 cm.	„

4. France.

(a) Size Limits.

General prohibition of capture, use or sale of all fish less than 10 cm., measured from the eye to the root of the tail, except in case of „fish of passage" and those not growing larger than 10 cm., as above measured. In addition there are the following minimum sizes (measured from eye to root of tail):—

Salmon ..... 40 cm.
Trout, char, grayling, grey mullet, bream, shad, lampreys and whitefish *(Coregonus lavaretus)* ..... 14 cm.
Eel ..... 25 cm.
Sturgeon ..... 100 cm.
Lobster[1]) ..... 20 cm.
Crawfish[1]) *(Palinurus)* (North Sea, Channel and Atlantic Coasts) ..... 20 cm.
(Mediterranean coast). ..... 18 cm.

[1]) Measured from tip of rostrum to end of tail.

(b) Mesh Regulations.

In general, fixed nets and drag nets used inside territorial waters and the large seine must have meshes measuring at least 25 mm. from knot to knot. There are however exceptions — for certain drag nets used in the Mediterranean and for certain kinds of fishery, e. g., for small species and for shrimps and prawns.

5. Germany.

(a) Size Limits.

Plaice[1]) in Oldenburg (North Sea coast), Bremen, Hamburg and the Baltic coast of Prussia, east of th line Utlängan—German-Polish frontier ..... 18 cm.
in Lübeck, Mecklenburg-Schwerin, and the Baltic coast of Prussia, west of the line Gjedsen—Ahrenshoop ..... 24 cm.
between this line and the line Utlängan to German-Polish frontier the limit is ..... 21 cm.
Flounder[1]) in Prussia (North Sea coast), Oldenburg (North Sea coast), Bremen, Hamburg and the Frisches Haff ..... 15 cm.
in Lübeck, Mecklenburg-Schwerin and Baltic coast of Prussia west of the line Gjedser—Ahrenshoop ..... 22 cm.
between this line and the line Utlängan to German-Polish frontier the limit is ..... 20 cm.
east of the last named line ..... 18 cm.
Turbot in Lübeck ..... 25 cm.
Eel in Prussia (North Sea coastal waters) and Hamburg ..... 25 cm.
in Bremen and Mecklenburg-Schwerin ... 30 cm.
in Oldenburg (coastal waters) and Lübeck 32 cm.
in Prussia (Baltic coast) ..... 35 cm.
Salmon in Prussia, Oldenburg and Lübeck ..... 35 cm.

[1]) See Addendum (p. 13) for regulations imposed in May, 1934. (24 cm. for plaice on North Sea coast).

in Bremen, Hamburg and Mecklenburg-Schwerin ..... 50 cm.
Sea Trout in Bremen, Hamburg and Mecklenburg-Schwerin ..... 28 cm.
in Prussia, Oldenburg and Lübeck ..... 35 cm.
Coregonus oxyrhynchus in Bremen, Hamburg and Mecklenburg-Schwerin ..... 20 cm.
in Prussia and Oldenburg ..... 28 cm.
Alosa vulgaris } ..... 20 cm.
„ *finta* }
in Prussia (North Sea coastal waters) and in Frisches Haff;
in Prussia (Baltic Coast), Oldenburg, Bremen, Hamburg and Mecklenburg-Schwerin ..... 28 cm.
Sturgeon in Oldenburg, Bremen, Prussia (Baltic coast) and Mecklenburg-Schwerin ... 100 cm.
in Prussia (North Sea coastal waters) and Hamburg ..... 150 cm.
Perca fluviatilis ..... 15 cm.
Leuciscus rutilus ..... 15 cm.
Lucioperca sandra in Hamburg and Frisches and Kurisches Haff ..... 28 cm.
in Prussia, Oldenburg, Bremen and Mecklenburg-Schwerin ..... 35 cm.
Abramis brama in Prussia ..... 25 cm.
in Oldenburg, Bremen, Lübeck and Mecklenburg-Schwerin ..... 28 cm.
Lobster in Prussia (North Sea coast) from tip of rostrum to hinder edge of carapace ..... 9 cm.

(b) Mesh Regulations.

Regulation of fishing gear is by means of Laws in the States having a relatively short coast line; in the other States, owing to the diversity of conditions, regulations are made by local Order. In all States a general minimum mesh has been in force for many years. It is 2.5 cm., measured from the middle of one knot to the middle of the next, when the net is wet. This is valid for all kinds of nets, except where special minima are prescribed. As this mesh is too small for many species and too large for others, it has in many areas been increased or decreased by Law for particular kinds of gear. There are therefore numerous exceptions to the general limit of 2.5 cm., a summary of which will be found in the Annexe (p. 11).

6. Holland.

(a) Size Limits.

None, except in territorial waters in the province of Zeeland, where the following are in force — Plaice 16 cm.; Dab 16 cm.; Flounder 18 cm. (also in Waddenzee and Zuiderzee); Sole 20 cm.; Lobster 11 cm. from tip of rostrum to hinder edge of carapace.

(b) Mesh Regulations.

None, save for certain inshore fishing gear in Zeeland; the regulations are under revision. In the

Waddenzee there is a limit of 17 mm. for the cod-end meshes in drag nets (kuilen).

7. Irish Free State.

(a) Size Limits.

There are no statutory size limits of general application, but it is forbidden to take or have in possession the smolts or fry of salmon and trout and the fry of eels. There are local size limits, fixed by Byelaw, for salmon, trout and eels.

(b) Mesh Regulations.

The minimum mesh for all nets used for the capture of salmon and trout in tidal and fresh water is 1¾ inches from knot to knot along the side of the square, or 7 inches all round, measured wet. This provision may be modified by local Byelaw. In certain areas within territorial waters the mesh of seine or drag nets is restricted to 1¾ inches by Byelaw, with the object of protecting salmon.

There is a general prohibition of the use of nets covered with canvas, hide or other material, whereby undersized or young fish might be taken or destroyed.

8. Latvia.

(a) Size Limits,

for fish caught "in the sea".

Pleuronectidae	15 cm.
Eel	50 cm.
Salmon	50 cm.
Sea Trout	35 cm.
Coregonus	30 cm.
Lucioperca sandra	35 cm.
Abramis vimba	20 cm.

(b) Mesh Regulations.

General minimum	2.5 cm.,	knot to knot.
Sprat and Herring Nets	1.1 cm.	„ „ „
Nets for Pleuronectidae	3.8 cm.	„ „ „
„ „ Eels	1.8 cm.	„ „ „

9. Norway.

(a) Size Limits.

1. General.

Plaice 27 cm. / Lobster 21 cm. } Capture prohibited.

Salmon / Sea Trout: Capture prohibited under 20 cm. sale or disposal prohibited under 30 cm.

Sprats: 9 cm. for canning. Catches must not contain more than 40 % below this limit, except catches for bait.

Herring: There is some limitation on catching of herring less than one year old.

The above regulations apply to the whole country.

2. Skagerak coast.

Cod 25 cm. / Flounder 20 cm. / Eel 34 cm. } Prohibition of sale or disposal.

(b) Mesh Regulations.

Nets for Salmon and Sea Trout 5.8 cm. knot to knot. (For shrimp trawls the mesh must not exceed 1.74 cm. from knot to knot, otherwise the instrument ranks as a fish trawl and its use is prohibited in territorial waters).

10. Poland.

Fishing in depths of less than 20 m. is prohibited.

(a) Size Limits (Prohibition of sale).

Plaice	18 cm.
Flounder	18 cm.
Dab	18 cm.
Turbot	18 cm.
Salmon	35 cm.
Sea Trout	35 cm.
Coregonus lavaretus	28 cm.
Sturgeon	100 cm.
Eel	35 cm.
Perca fluviatilis	15 cm.
Leuciscus rutilus	15 cm.

In brackish water.

(b) Mesh Regulations.

Minimum Meshes:—

Drift Nets for Salmon and Sea Trout	35 mm.
„ „ „ Herring	18 mm.
„ „ „ Sprats	11 mm.
Fixed nets for flat fishes	45 mm.
Trawls for plaice, flounder and dab	45 mm.

The measurements are taken from knot to knot when the net is wet.

11. Portugal.

(a) Size Limits (Prohibition of capture and sale).

Flat fishes	14 cm.
Sardine	ca. 13 cm.
Horse Mackerel *(Trachurus)*	ca. 12 cm.
Bass *(Morone labrax)*	15 cm.
Grey Mullet *(Mugil)*	15 cm.
Gurnards *(Trigla)*	15 cm.
Eel	25 cm.
Alosa vulgaris	30 cm.

(b) Mesh Regulations.

The general minimum for sardine nets is 12 mm., knot to knot, measured wet, by exception 9—10 mm.

12. Spain.

(a) Size Limits.

Hake	18 cm.
Megrim	13 cm.
Sole	13 cm.
Rhombus	14 cm.

Rhamphistoma belone ..... 25 cm.
Morone labrax ..... 22 cm.
Trachurus ..... 11 cm.
Lepidotus raii ..... 16 cm.
Sciaena umbra ..... 15 cm.
Mullus barbatus ..... 11 cm.
Dentex dentex ..... 16 cm.
Sparus acarne (Altantic) ..... 18 cm.
Sparus acarne (Mediterranean) ..... 15 cm.
Box boops ..... 8 cm.
Aurata aurata ..... 19 cm.
Pagrus ..... 15 cm.
Mackerel ..... 23 cm.
Mugil ..... 14 cm.
Lophius ..... 28 cm.
Lobster *(Homarus)* and Crawfish *(Palinurus)* ..... 20 cm.
(Eye to root of telson)
Norway Lobster *(Nephrops)* ..... 10 cm.
(Eye to root of telson)
Edible Crab *(Cancer)* ..... 8 cm.
(Breadth of carapace)

(b) Mesh Regulations.
None.

13. Sweden.

(a) Size Limits.
Plaice ..... 27.0 cm.
in Skagerak, Kattegat and Sound.
In Baltic — west of Gjedser—Ahrenshoop 24 cm.
between this line and the line Utlängan—German-Polish frontier ..... 21 cm.
east of the last named line ..... 18 cm.
Flounder ..... 22 cm.
in Baltic — west of Gjedser—Ahrenshoop,
between this line and the line Utlängan—German-Polish frontier ..... 20 cm.
east of the last named line..... 18 cm.
Witch ..... 30 cm.
in Skagerak and Kattegat.
Haddock for export to Great Britain... 34 cm.
Catfish for export to Great Britain ... 60 cm.
Salmon ..... 30 cm.
in Laholmbugt,
in coastal area off Norrbotten Län ..... 35 cm.
in Gothenburg and Bohus Län, Hallands Län and coastal area off Kristianstad Län, Blekinge Län and Kalmar Län..... 50 cm.
Sea Trout ..... 30 cm.
in Gothenburg and Bohus Län, Laholmsbugt and coastal area off Malmöhus Län,
in Hallands Län and coastal areas off Kristianstad Län, Blekinge Län, Kalmar Län and Norrbotten Län ..... 35 cm.
Eel ..... 35 cm.
in Gothenburg and Bohus Län.
Lobster ..... 21 cm.
for whole country.

14. United Kingdom.

(Great Britain and Northern Ireland).

(a) Size Limits.

1. Under the Sea-Fishing Industry Act, 1933, Section 4, orders may be made prescribing the size below which any specified kind of sea-fish (including shellfish) may not be sold or offered for sale. The Act does not apply to salmon and migratory trout. By an Order dated July 29th, 1933, the following size limits were laid down:—
Hake ..... 13 inches (33 cm.)
Haddock ..... 9½ „ (24 cm.)
Plaice, Dabs and Soles 9 „ (23 cm.)
This Order applies to Great Britain and not to Northern Ireland, but an identical Order was made in Dec., 1933, by the Government of Northern Ireland.

For additional size limits imposed in 1934, see p. 4.

2. In certain areas within the Scottish exclusive fishery limits on the East Coast and in Shetland, the landing of flatfish under 10 inches (25.4 cm.) in length is prohibited by Byelaws Nos. 40 and 41 made by the Fishery Board for Scotland.

3. Under the Fisheries (Oysters, Crabs and Lobsters) Act, 1877, the taking of edible crabs *(Cancer pagurus)* under 4¼ inches in breadth, and of lobsters under 8 inches in total length, is prohibited in Great Britain and Northern Ireland. These size limits may be abrogated by Orders made under the Sea-Fishing Industry Act, 1933, prescribing size limits for sale.

By the Sea-Fisheries Regulation Act, 1888, the size limits for crabs and lobsters may be increased under Byelaws made by the Local Sea Fisheries Committees in England and Wales, but the jurisdiction of these Committees is limited to territorial waters. In the areas of several Committees these limits have been raised to 4½ or 5 inches for crabs and 9 inches for lobsters.

A size limit of nine inches for crayfish *(Palinurus)* is imposed in the South Wales Sea Fishery District.

4. The capture and sale of "immature" salmon, trout or freshwater fish in England and Wales is prohibited by the Salmon and Freshwater Fisheries Act, 1923, "immature" being defined in the case of salmon to mean that the fish is of a length of less than 12 inches (30 cm.) from the tip of the snout to the fork of the tail, and in the case of trout and freshwater fish such size as may be prescribed by Byelaw. Various size limits for trout and freshwater fish are imposed by Byelaw in the Fishery Districts constituted under this Act.

5. In Scotland no statutory size limits (except 8 inches for brown trout) are imposed on salmon, trout and freshwater fish, but the capture of the "young" of salmon and trout is prohibited.

6. In Northern Ireland the possession is prohibited

of freshwater eels any fourteen of which weigh less than 7 lbs.

(b) Mesh Regulations.

1. Orders may be made under the Sea-Fishing Industry Act, 1933, Section 3, prescribing a minimum mesh for nets carried on board British fishing vessels. They may fix different minimum sizes of mesh for different fish and for different methods of fishing, but they do not apply to the carrying of nets for the purpose of fishing within the three-mile limit, within which limit the mesh of various types of net is regulated in England and Wales by the Byelaws of the Local Sea Fisheries Committees and in Scotland by the Byelaws made by the Fishery Board (See 2 below).

An Order under the Act, dated July 29th, 1933, prescribes that "No fishing boat registered in the United Kingdom shall carry for the purpose of catching sea-fish of any description, other than herring or shrimps, in any waters distant more than three nautical miles from the coast of any part of the United Kingdom measured from low water mark of ordinary spring tides, any trawl or seine net, or other net having a bag, pocket or cod-end which has in the bag, pocket or cod-end thereof a smaller mesh than is represented by —

21 rows or rounds to the yard when the net is unused and untreated with any preservative.

22 rows or rounds to the yard when the net is unused and treated with some preservative.

24 rows or rounds to the yard in any condition whatever.

The net shall in all cases be stretched lengthwise for the purpose of measurement, and the measurement shall be taken from the inside of the first knot on the piece of net which is being measured."

The "rows or rounds" refer to the knots in the stretched net, and accordingly the minimum size prescribed is practically equivalent to 12 stretched meshes to the yard. This gives approximately a 3 inch mesh, measured from inside one knot to outside the opposite knot when the mesh is pulled taut lengthwise.

2. In most of the Local Sea Fisheries Districts of England and Wales the mesh of trawls (and other nets) is regulated by Byelaw, a 2 inch or a 3 inch mesh being generally prescribed for trawls. Certain of the Byelaws made by the Fishery Board for Scotland, regulating fishing in Scottish exclusive fishery limits, authorise, as an exception to a general prohibition, seining or trawling for white fish in inshore waters off limited parts of the Scottish coast, subject to specified reservations including minimum sizes of the mesh of the gear, as follows:—

Byelaw No.	Region where applicable.	Minimum Mesh.
34	Firth of Clyde	Wings 2½ ins. square. Bag 2 „ „
35	Luce Bay	2 „ „
37	Solway Firth	1½ ins. or 1¾ ins. square, according to season, locus, and type of gear.
40	East Coast (including Firth of Forth)	Wings 2¾ ins. square. Bag 2 ins. square.
41	Shetland	Wings 2¾ (temporarily 2½) ins. square. Bag 2 ins. square.

These measurements are taken from knot to knot.

3. In Northern Ireland there are certain local regulations applying to Dundrum Bay and Belfast Lough prescribing a minimum size of mesh for the capture of sea-fish. There is a general prohibition of the use of nets covered with canvas, hide or other material by which unsizable young fish might be taken.

4. In England and Wales the use of a net having a mesh of less dimensions than 2 inches from knot to knot for the purpose of taking salmon or migratory trout is prohibited by Section 7 of the Salmon and Freshwater Fisheries Act, 1923. This provision may however be modified by Byelaws made by the Fishery Boards constituted under the Act, who have the general power of determining the mesh of nets to be used for taking salmon, trout and freshwater fish.

5. In Scotland the nets used for the capture of salmon and sea trout must have a mesh not less than 1¾ inches from knot to knot.

6. In Northern Ireland the nets used for taking salmon and trout in the sea and tidal waters and any fish in freshwater must have a mesh not smaller than 1¾ inches from knot to knot, measured wet, subject to special local regulations.

ANNEXE.

Local Mesh Regulations in Germany.

I. Preussen (Nord- und Ostsee).

Fischereigesetz vom 11. Mai 1916 § 106.

Vorbehaltlich der §§ 100, 107 bis 114 können durch Polizeiverordnung Bestimmungen über folgende Gegenstände getroffen werden:

1. . . . .
2. . . .
3. weitergehende Verbote und Beschränkungen . . . hinsichtlich der Art und Beschaffenheit der Fanggeräte.
4. — 12. . . .

Vor Erlass einer Polizeiverordnung nach Abs. 1 Ziffer 3 sollen Beteiligte gehört werden.

Die Polizeiverordnung zum Fischereigesetz vom 29. März 1917 (Fischereiordnung) bestimmt über die Maschenweite zur Zeit folgendes:

§ 24.

Die Maschen von Stellnetzen, Staaknetzen, Stosshamen (Steckladen), Treibnetzen, Wurfnetzen, Zugnetzen (Garnen) und Grundschleppnetzen müssen in nassen Zustande von der Mitte des einen bis zur Mitte des anderen Knotens gemessen, eine Weite von mindestens 2,5 cm. haben. In Küstengewässern kann der Regierungspräsident für den Fang von Lachsen, Meerforellen, Zandern, Schollen und Flundern grössere Maschenweiten vorschreiben. Bei Fanggeräten für Heringe, Sprotten, Stinte, Üklei, Elbritzen, Kaulbarsche, kleine Maränen, Garnelen und Schmerlen kann er engere Maschen zulassen und für Reusen und Säcke in den Küstengewässern eine Maschenweite festsetzen.

§ 25.

§ 24 gilt nicht für die Kehlen von Netzen, den hinteren Sackteil (Schlussnetz, Stoss) von Zug- und Grundschleppnetzen sowie nicht für Netze zum Fang von Aalen, Bach- und Regenbogenforellen, Stichlingen und Köderfischen. Für den hinteren Sackteil bei Grundschleppnetzen, Aalhamen und auch bei Ankerkuilen kann der Regierungspräsident jedoch bestimmte Maschenweiten oder Vorrichtungen zum Schutze der gefangenen Fische vorschreiben.

Von den Ermächtigungen der § 24 Satz 2 und 3 und § 25, Satz 2 ist in vielen Regierungsbezirken Gebrauch gemacht worden. Insbesondere ist das in den Gebieten der Ostseeküstengewässer geschehen, die fiskalisches Eigentum sind, um möglichste Gleichförmigkeit der Fanggeräte der verschiedenen Pächter zu schaffen. Einige Beispiele:

Fanggeräte des Kurischen Haffs.

Das gewöhnliche Keitelgarn darf im Vorderteil bis 1,9 cm. im Mittelrock bis zu 1,6 cm. und im Achtergarn bis 1,3 cm. herabgehen.

Das Stintkeitelgarn. Die Maschen dieses ausschliesslich für den Stintfang bestimmten Geräts dürfen im Vorderteil bis zu 1,3 cm., im Mittelrock bis zu 1,0 cm. hinabgehen und im Achtergarn beliebig gross sein.

Das Kurrengarn. Die Maschenweite dieses hauptsächlich für den Zanderfang bestimmten Geräts darf nicht weniger als 3,5 cm. betragen.

Fänggeräte des Frischen Haffs.

Das Keitelgarn. Die Maschen können im Herd bis zu 2.0 cm., im Mittelrock bis zu 1.8 cm., im Achtergarn bis zu 1.5 cm. herabgehen

Das Strömlings-(Herings-)netz. Maschenweite bis wenigstens 1.8 cm. zugelassen.

Ostseegewässer von Ostpreussen.

Im zum Heringsfang benutzten Strandgarn darf die Maschenweite in der Mettritze (letzter Teil des Sackes) bis auf 1.3 cm., bei dem Strandgarn zum Sprottenfang dort bis 0.8 cm. hinabgehen.

Seestint und Sprottenstellnets — Maschenweite ist bis 1.0 cm. zulässig.

Im **Regierungsbezirk Stettin** können folgende Geräte geringere Maschenweite als 2.5 cm. haben: Ükleinetze, Kaulbarschnetze, die Ruderzeese, die gewöhnlichen Zeesen (Grundschleppnetze). Stintzeesen, Stichlingszeesen, Streuer, Garne etc. Dagegen ist für das zum Zanderfang bestimmte Treibgarn eine Maschenweite von mindestens 3.5 cm. vorgeschrieben.

Im Regierungsbezirk Stralsund.

Für Heringsnetze ist eine Maschenweite von 1.8 cm. gestattet. Ferner bestehen für Garne, Zeesen, Streuer ähnliche Bestimmungen wie im Regierungsbezirk Stettin.

Schleswig-Holstein Ostseeküste sowie die gesamte Nordseeküste Preussens.

Bei Fanggeräten für Heringe, Sprotten, Stinte, Üklei, Ellritzen, Kaulbarsche, kleine Maränen und Schmerlen werden Maschenweiten von 1 cm, bei Fanggeräten für Garneelen solche von 0.8 cm. zugelassen.

(Die sehr ins Einzelne gehenden Verordnungen der Preuss. Regierungspräsidenten stehen, falls sie dort benötigt werden, zur Verfügung.)

II. Oldenburg (Nord- und Ostsee).

Fischereigesetz vom 26. Februar 1929.

§ 20.

„Vorbehaltlich der Bestimmungen dieses Gesetzes wird im Verwaltungswege vorgeschrieben:

1. .....
2. ....
3. welche Fangarten und welche Arten von Fanggeräten beim Fischfang verwendet werden dürfen,
4. von welcher Beschaffenheit die erlaubten Fanggeräte sein müssen und mit welchen Beschränkungen die letzteren zum Fischfang gebraucht werden können.
5. , 6. ...."

Die Ausführungsbestimmungen sagen in § 4 dazu folgendes.

§ 4 (zu § 20 des Gesetzes)

"3. Beim Fischfange dürfen vorbehaltlich der nachfolgenden Ausnahmen keine Fanggeräte (Netze und Geflechte jeder Art und Benennung) angewendet werden, deren Öffnungen (Maschen) im nassen Zustande an jeder Seite (von Knoten zu Knoten) nicht mindestens eine Weite von 2.5 cm. haben.

Bei Aalfanggeräten kann die Maschenweite des hinteren Netzteiles (Sack, Schluss, Stoss) bis auf 1 cm. herabgemindert werden. Bei Aalfängen ist der Lattenabstand auf mindestens 2 cm. zu bemessen.

Dem Ministerium des Innern bleibt vorbehalten, Ausnahmen von diesen Vorschriften im Falle des Bedürfnisses für bestimmte Arten von Fanggeräten zuzulassen.

Für den Fang von Heringen, Sprotten, Stinten, Uklei, Ellritzen, Kaulbarschen, Schmerlen, Neunaugen und Garnelen (Granat) sind Fanggeräte mit einer Maschenweite von wenigstens 10 mm. zulässig, für den Fang von Garnelen (Granat) mit Körben solche mit einer Stabweite von wenigstens 4 mm."

III. Mecklenburg (Ostsee).

Die "Grossherzogliche Verordnung betreffend den Fischereibetrieb, vom 18. März 1891" bestimmt bezüglich der Maschenweite in Binnen- und Küstengewässern folgendes:

§ 7

"Beim Fischfange dürfen, vorbehaltlich der nachfolgenden Ausnahmen, keine Fanggeräte (Netze, Geflechte

etc.) irgendwelcher Art und Benennung angewendet werden, deren Öffnungen (Maschen) im nassen Zustande an jeder Seite (von der Mitte des einen Knotens bis zur Mitte des anderen Knotens gemessen) nicht mindestens eine Weite von 2.5 cm. haben.

Diese Vorschrift erstreckt sich auf alle Teile und Abteilungen der Fanggeräte; bei Netzen mit sogenannten Kehlen findet jedoch das Mindestmass auf die Kehle keine Anwendung.

Bei Fanggeräten, welche ausschliesslich zum Fange von Aal, Neunauge, Stichling, Hering, Hornfisch, Krabbe bestimmt und geeignet sind, wird von einer Bestimmung der Mindestweite der Öffnungen oder Maschen abgesehen.

Ausnahmen von der vorgeschriebenen Maschenweite können im Falle des Bedürfnisses für bestimmte Fanggeräte und den Fang bestimmter Fischarten, namentlich Stint und Wiedick (Üklei) zugelassen werden. In allen solchen Fällen können jedoch über die Art, Grösse und Einrichtung dieser Fanggeräte und über den Umfang, die Art und die Zeitdauer ihrer Verwendung einschränkende Bestimmungen getroffen werden."

Für die Küstengewässer sind folgende Ausnahmen vorgesehen.

§ 19 Ziffer 2.

"2. Bei allen denjenigen Fanggeräten, welche aus zwei Flügeln oder zwei Leinen und einem Sack bestehen, sind für die hintere Hälfte des Sacks Maschen von beliebiger Weite gestattet.

Auch brauchen bei diesen Fanggeräten, wenn ihr Sack keine Kehle hat — Waden —, die Maschen der vorderen Hälfte des Sackes nicht weiter als 1.5 cm. sein.

Für Zeesen, d. i. Fischergezeuge, welche aus einem mit einer Kehle versehenen Sack und zwei Flügeln oder Leinen bestehen, soll es genügen, wenn die Maschen in dem vorderen Teile des Sackes und in den Flügeln eine Weite von 1.7 cm. haben."

IV. Lübeck (Ostsee).

Die "Fischereiordnung für den Lübeckischen Freistaat, vom 27. April 1887" enthält die folgenden Bestimmungen:

§ 19

Beim Fischfange dürfen, vorbehaltlich der nachfolgenden Ausnahmen, keine Fanggeräte (Netze und Geflechte jeder Art und Benennung) angewendet werden, deren Öffnungen (Maschen) im nassen Zustande an jeder Seite (von der Mitte des einen Knotens bis zur Mitte des anderen Knotens gemessen) nicht mindestens eine lichte Weite von 25 mm. haben. Diese Vorschrift ertreckt sich auf alle Teile oder Abteilungen der Fanggeräte.

§ 20.

Bei dem Betriebe der Küstenfischerei dürfen nachfolgende Fanggeräte mit geringerer als der im § 19 vorgeschriebenen Maschenweite verwandt werden:

1. Garne (Zuggarne, Waden), wenn sie in den Flügeln mindestens 22 mm. und im Sack mindestens 13 mm. Maschenweite haben. Für die Waden zum Heringsfang wird dieses Minimalmass auf 16 mm. in den Flügeln und 10 mm. im Sack herabgesetzt.

Zum Zwecke des Fanges von Tobias ist die Anwendung von kleinen Garnen am Ostseestrande ausnahmsweise auch vom 1. Mai bis zum 31. August mit einer Maschenweite von 9 mm. im Hintergarn (Punt des Sackes) bei einer Länge desselben von höchstens 1.75 m. erlaubt.

2. Heringsreusen und Heringsstellnetze, wenn sie durchweg eine Maschenweite von mindestens 16 mm. haben, jedoch nur vom 1. Januar bis zum 30. Juni bei offenem Wasser.

3. Krabbenkörbe (Reusen) und Krabbenhamen mit einer Maschenweite von mindestens 6 mm. und im Sack von mindestens 4 mm., jedoch nur vom 15. April bis 15. September.

§ 24.

Aus Ruten oder Rohr gefertigte Korbreusen müssen zwischen dem Flechtwerk Zwischenräume von mindestens 5 mm. Bügelreusen eine Maschenweite von mindestens 10 mm. haben."

V. Hamburg (Nordsee).

Revidiertes Gesetz betreffend die Ausübung der Fischerei im Hamburgischen Staate. Vom 15. Juni 1887.

§ 15

"Einrichtung der Fanggeräte.

Es dürfen beim Fischfange in nicht geschlossenen Gewässern vorbehaltlich der nachfolgenden Ausnahmen keine Fanggeräte (Netze und Geflechte jeder Art und Benennung) angewendet werden, deren Öffnungen (Maschen) im nassen Zustande an jeder Seite von der Mitte des einen Knotens bis zum anderen Knoten nicht mindestens eine Weite von $2^1/_2$ cm. haben. Diese Vorschrift erstreckt sich auf alle Teile oder Abteilungen der Fanggeräte, jedoch findet auf die s. g. Kehlen von Fischergezeugen das Mindestmass keine Anwendung.

Die obige Maschenweite ist nicht erforderlich für Netze und Geräte, welche ausschliesslich zum Fange von Aalen, Heringen, Breitlingen (Sprotten), Sardellen, Stinten, Neunaugen und Granaten (Krabben) bestimmt sind."

VI. Bremen (Nordsee).

Fischereigesetzt vom 27. Mai 1888. Im Abschnitt "Beschränkung im Gebrauch der Fangmittel" behandelt der § 18 dit Maschenweite. Er lautet:

"Vorbehaltlich besonderer im Falle des Bedürfnisses von der Oberaufsichtsbehörde für bestimmte Arten von Fanggeräten zuzulassender Ausnahmen dürfen keine Fanggeräte (Netze und Geflechte jeder Art und Benennung) angewandt werden, deren Öffnungen (Maschen) im nassen Zustande an jeder Seite (von der Mitte des einen Knoten bis zur Mitte des anderen Knotens gemessen) nicht mindestens eine Weite von 2.5 cm. haben.

Diese Vorschrift erstreckt sich auf alle Teile oder Abteilungen der Fanggeräte, jedoch findet dieselbe keine Anwendung auf solche Geräte, welche nur zum Fang von Hering, Stint, Aal, Neuauge, Bleeken (Uckelei) und Stichling bestimmt und geeignet sind. Ebenso findet bei Netzen mit sogenannten Kehlen (Einkehlen) das Mindestmass auf die Kehle keine Anwendung."

ADDENDUM.

Reichsgesetzblatt Teil I Nr. 48, 4. Mai 1934, S. 353.

Gesetz zum Schutze der Nordseeschollenfischerei. Vom 30. April 1934.

Die Reichsregierung hat das folgende Gesetz beschlossen, das hiermit verkündet wird:

§ 1.

Schollen *(Pleuronectes platessa)* in der Grösse unter 24 cm — gemessen von der Kopfspitze bis zum Ende des längsten Teiles der Schwanzflosse — dürfen in den deutschen Nordseeküstengewässern nicht an Bord behalten oder mitgeführt, in den Häfen und an den Küsten der deutschen Nordseeküstengewässer nicht an Land gebracht, feilgeboten, verkauft oder von dort weiterbefördert werden.

§ 2.

Der Reichsminister für Ernährung und Landwirtschaft oder die von ihm bezeichneten Behörden können

1. Ausnahmen zu wissenschaftlichen Zwecken bewilligen,
2. für die ausschliesslich zur Verarbeitung zu Trockengarneelen bestimmten Fänge der Krabbenfischer eine Beimischung an untermassigen Schollen bis zu 4 vom Hundert des Garneelengewichts zulassen.

§ 3.

Wer vorsätzlich oder fahrlässig den Vorschriften dieses Gesetzes zuwiderhandelt, wird, sofern die Tat nicht nach anderen Vorschriften mit schwererer Strafe bedroht ist, mit Geldstrafe oder mit Gefängnis bis zu sechs Monaten bestraft.

§ 4.

Dieses Gesetz tritt einen Monat nach Verkündung in Kraft.

Berlin, den 30. April 1934.

Der Reichskanzler
ADOLF HITLER.

Der Reichsminister
für Ernährung und Landwirtschaft
R. Walther Darré.

Reichsgesetzblatt Teil I Nr. 48, 4. Mai 1934, S. 354.

Gesetz zum Schutze der Flundernfischerei in der Ostsee. Vom 30. April 1934.

Die Reichsregierung hat das folgende Gesetz beschlossen, das hiermit verkündet wird:

§ 1.

Für die Flunder *(Pleuronectes flesus)* der Ostsee wird eine jährliche Schonzeit festgesetzt, die mit dem 1. Februar beginnt und mit Ablauf des 31. März endet.

Während der Schonzeit dürfen Flundern, gleichviel welcher Herkunft, in den deutschen Küstengewässern der Ostsee nicht an Bord behalten oder mitgeführt, in den Häfen und an den Küsten der deutschen Ostseeküstengewässer nicht an Land gebracht, feilgeboten, verkauft oder von dort weiterbefördert werden.

§ 2.

Der Reichsminister für Ernährung und Landwirtschaft kann zu wissenschaftlichen Zwecken Ausnahmen bewilligen.

§ 3.

Wer vorsätzlich oder fahrlässig den Vorschriften dieses Gesetzes zuwiderhandelt, wird, sofern die Tat nicht nach anderen Vorschriften mit schwererer Strafe bedroht ist, mit Geldstrafe oder mit Gefängnis bis zu sechs Monate bestraft.

§ 4.

Dieses Gesetz tritt einen Monat nach Verkündung in Kraft.

Berlin, den 30. April 1934.

Der Reichskanzler
ADOLF HITLER.

Der Reichsminister
für Ernährung und Landwirtschaft
R. Walther Darré.

APPENDIX B.

Report on the Results of Experiments with Savings Gear.

By

F. M. Davis.

Fisheries Laboratory, Lowestoft.

General Considerations.

Borowik (2) has clearly defined savings gear and has shown that the commercial trawl has the power of "sifting" the catch and is thus in itself a saving gear. Such a result is a corroboration of Baranov (1), Bowman (3), Todd (16), Davis (6) and others.

A note of warning must, however, be sounded here. There is a considerable body of opinion among the fishing industry, and the view is also held by research workers, to a certain extent, that the meshes of a trawl, including those of the codend, are pulled tight fore and aft while the net is being towed. This would make an impervious bag, so that fish cannot be released through the meshes until the way is off the ship, and the net is being hauled. Those holding this point of view naturally consider that an increase in the size of meshes would be entirely useless as a means of sparing the lives of small fish, as those that were small enough to pass through the meshes when open, would be retained during towing and killed or injured. They would thus only be released either dead or moribund when the net was being hauled. It is probably largely due to this view that work was instituted on trawls with meshes of the semi-rigid or rigid type, as exemplified by the Ridderstad (11, 13) and Gelder (16) trawls.

The present writer considered the question of whether fish did or did not escape during the towing of the trawl of such fundamental importance that he instituted experiments calculated to solve the problem, and has been able to show that the greater proportion of the fish that escape through the codend do so during the period when the net is being towed and before it is hauled. (See Appendix C).

The writer considers it proved that, since the majority of fish that escape from the codend, do so during the towing of the net, the view that the ordinary trawl is a savings gear, the efficiency of which depends on the sizes of the meshes, is confirmed. Therefore, it is only necessary to know the correct size of mesh to use for each species of fish, since the optimum marketable sizes vary considerably from species to species. Rigid and semi-rigid meshes become unnecessary.

The fact that a saving effect can be produced by mere enlargement of mesh is of considerable practical importance. In attempting to produce any form of gear calculated to save undersized fish in a commercial fishery, it must be remembered that such a gear must be acceptable to the industry concerned. In other words, the standard type of gear that has been evolved by the industry — the trawl — must not be modified to any appreciable extent so as to make it more expensive to produce, unhandy to use, or difficult to mend. Mere enlargement of meshes carries with it none of these disadvantages. More complicated modifications, however, such as the Ridderstad or Gelder gear, are liable to increase the difficulties of operation and of mending, and, in the opinion of the writer, have no advantage over the ordinary trawl with enlarged meshes.

The problem of how to save unmarketable fish of any one species is therefore straightforward. Unfortunately, however, fish of different species and characteristics are fished simultaneously on the same grounds. Thus one will find two or more species in which the ratio of the lengths at which they are released by one type of gear under identical conditions differs from the ratio of the lengths at which it is considered desirable to catch or spare them. Therefore methods that will differentiate between different types of fish have been

considered. The Ridderstad principle of rigid rectangular meshes is an example of such methods.

Commercial fish may, with few exceptions, be divided into three main types. Round fish, e. g. haddock and herring, broad flat fish, e. g. plaice, and supple flat fish, e. g. sole. The difference in cross section between the former two classes is obvious: that between the latter two classes is superficially not so great, but on the other hand the sole with its great suppleness, muscular strength and rough ctenoid scales, is able to force itself through meshes where a plaice would be powerless so to do. The writer believes that, assuming approximate lengths can be fixed below which it may be considered desirable to spare fish of various species, it may be possible so to modify a trawl as to release round fish and broad flat fish at the desired lengths but he is also convinced that broad flat fish cannot be released at the desired lengths without the loss of considerable numbers of marketable soles. Although little information is available on this point, it would appear that soles can be roughly considered as round fish for the purpose of estimating the size at which they would be released.

It is obvious that since, as is well known, the mesh of a given size will release round fish at a greater length than broad flat fish, and since the size of release is a function of the size of mesh, the increase of mesh will produce any desired saving effect on round fish without producing a loss of marketable broad flat fish. It would appear also that the mesh for the saving of round fish would produce a certain loss of the smaller sizes of marketable soles. The question of the loss of small soles has been considered by Wollaston (4 d) who shows, for the inshore area worked by him, that the mesh that will give the optimum results as regards sparing small plaice will release excessive numbers of marketable soles. The writer, therefore, considers that the only true practical step that can be taken, as far as deep sea trawling is concerned, is to enlarge the meshes of trawls in order to produce the saving effect for the more important round fish, e. g. the haddock and the hake. Even here it must be remembered that one has to face a grave practical difficulty, inasmuch as a mesh that will produce a saving of either of these fish would be entirely useless for the capture of herring. The size of the herring available on the trawling grounds is such that the majority would be lost by any mesh calculated to release haddock and hake of the size it is desirable to spare. However it must be remembered that on herring trawling grounds the bulk of the catch consists of herring only, although at times considerable numbers of small fish of other species, e. g. hake, may be destroyed. These herring would be largely lost even by the present ordinary whitefish trawl.

Methods.

The greater part of the work carried out on the releasing power of meshes has dealt primarily with the meshes of codends. Todd (16) certainly covered the square and baitings of the trawl but no very satisfactory results were obtained. Borowik (2) has compared the catching power of trawls with different meshes in all parts of the net. It would seem, however, that since the size of the mesh of the codend appears to have a great influence on the sizes of the fish retained, it is simpler to confine one's attention to this part of the net, assuming that the industry would, if necessary, modify the remainder of its net to function best with the new codend. In this connection, one should remember that, in the Spanish trawl or bull net, the size of the codend meshes is considerably larger than that of the baitings meshes immediately in front of it (Santamaria (14) and other information). The collection of data as to the releasing power of meshes can be effected under three main heads.

1. Alternating hauls or series of hauls can be carried out with either a standard codend, or one of mesh small enough to sample the total population, and a codend of larger mesh. The catches of the standard or small codend and the large codend can then be compared.

2. The codend to be tested can be fitted with a cover of mesh small enough to retain fish of all sizes contained in the total population. This cover will retain all fish released through the meshes of the codend, and the method thus gives direct data.

3. The Trouser Method of Russell and Edser can be used. Here the codend is bifid, each half being built of a different mesh. It is thus certain that the two halves of the codend are subject to the same conditions and fishing the same population at the same time, and that the catches in each can be directly compared.

Method (1) though sound in principle, is open, when carried out from a research vessel, to the grave practical objection that very large numbers of hauls are necessary in order to make sure that the same population is being fished in both series of hauls. Otherwise one cannot be satisfied that the hauls of the standard and experimental (larger) codends are comparable one with the other, owing to the liability to variation in composition by size, of the shoals of fish taken even on the same ground. The writer considers that this method can only be adequately used by commercial vessels over a long period. The results of such a test are set out in Appendix D.

Method (2). It has often been stated verbally, and is the opinion of many workers, that the use of a cover of small meshed net causes the codend to retain a larger number of small fish than it would if fished without a cover. It is suggested that the cover spoils the draught of water

passing through the net or lies close against the meshes of the codend thus preventing the passage of fish through them by causing a direct physical masking. Should this criticism be valid it is obvious that the cover net experiments would give false results. The writer, therefore, carried out control experiments with a view to finding out whether a well designed and well set cover had, in practice, any appreciable effect on the proportion of fish retained and released at various sizes, or alternatively, whether, if such an effect existed, it was or was not measurable.

It is obvious that if the cover is of such a type that in action it is liable to become closely applied to the codend, and does not form a clear bag when the net is being towed, there must be a definite blanketing effect which will cause a retention of fish that would be able to escape were there no such cover. A cover that will flow clear and not sag on to the codend is therefore essential. That used by the writer was of the type used in the Swedish experiments on the Ridderstad saving trawl (13), the shrimp netting being supported clear of the codend by means of rattan canes. There was thus formed above the codend a spacious chamber which was continued backwards as the bag of the cover. The underside of the main codend was also lined with shrimp netting. The reason for this step was that, as the underside of a normal codend is already blanketed to a certain extent by its presumably close application to the ground and by the false "bellies" or "rubbers", it was thought that the data would be easier to interpret if the escape of the fish from the underside were completely eliminated. It certainly ensures that the figures of the proportions of the various sizes escaping from the whole codend are minimal.

Control experiments were carried out by the present writer, and one method of treatment was shown in (6). Further treatment of this data, though not producing complete proof, gives considerable grounds for belief that there is a masking or "prevention of escape from the codend" effect on the smallest sizes of fishes only, and that this effect in practice does not vitiate the results of the experiments, as a correction can be applied. At the worst, the results arrived at by covered codend methods appear to give results showing the releasing power of meshes as minimal.

Method (3). The trouser method is most useful for preliminary work and rapid experiment in order to obtain rough indications of the best size of mesh to use in main experiments. In addition to its obvious limitations as compared with the normal codend, the trouser codend showed, in the English experiments, a tendency for one leg, the "after", to take considerably more fish than the other. Provided, however, that the mesh to be tested (i. e., the larger) forms the after leg and the control mesh the other, it has been found that reasonably accurate results can be obtained.

Method (2) is the only one that will give direct and absolute results; that is to say, one can produce graphs showing for any mesh the percentage of any species released at each cm. length. In this connection, the method devised by Wollaston (4a, 4b) for producing the selection ogive should be studied. Methods (1) and (3) will not give absolute but only comparative results, unless the standard mesh is of a size sufficiently small to retain the total population of the species under investigation. If, in methods 2 and 3, the number of each fish at each length taken by the mesh under test (the larger) is subtracted from that taken by the standard or smaller mesh, the difference in the two numbers can be assumed to be the number of fish released at each length by the tested mesh and a percentage graph of the results can be obtained. A useful criticism by Wollaston (4c) should be borne in mind. It has been the custom of many workers, e.g. Tesch (15) and others, to found their judgment on the selective action of a net on the number of fish retained and released above and below a certain arbitrary size. The chosen size or "dividing line" is usually the size below which the fish are unmarketable. Wollaston shows that the relative numbers above and below the dividing line are, of necessity, greatly influenced by the actual composition of the shoals fished. He states, "There is only one reliable method for estimating the selective action of a net. This is to deduce the 'Selection curve' or 'Selection ogive' giving the percentage taken and released in each length group, the class intervals being taken small enough to allow of at least four or five points on such a curve". For details of the method see (4a) and (4b).

A considerable amount of work has been carried out on the size of fish that are released by various meshes, but it is difficult accurately to co-ordinate the results owing to the fact that there is a great deal of variation in the method of stating the sizes of meshes. Furthermore, many writers omit to state the material of which the net is made, or whether the twine is single or double, etc. It is obvious that for meshes made on the same spool, the size of the actual opening through which fish will escape, will vary inversely with the size of the material composing the mesh. Thus, if two pieces of net are made on a spool of x cm. circumference, one of fine single cotton and the other of coarse double trawl twine, the actual lumen of the mesh will be larger in the former.

The present writer used as his standard measurement the circumference of the spool on which the mesh is made and paid little attention to the size of the actual mesh. In this connection it must be remembered that the size of mesh after a certain amount of fishing may vary considerably from net

Table I.

I. Sample	II. Material	III. Metres per Kilo	IV. White or Dressed	V. Single or Double	VI. Spool cm	VII. Length of mesh	VIII. Rows per metre
1	manilla 3 ply.	200	White	Double	C. 5	3.8	39.6
2	,,	,,	,,	,,	D. 6	5.1	31.5
3	,,	,,	,,	,,	E. 7	6.1	27.5
4	,,	,,	,,	,,	F. 8	6.4	24.4
5	,,	,,	,,	,,	G. 9	8.2	21.7
6	,,	,,	,,	,,	H. 10	8.8	19.5
7	,,	,,	Tarred	,,	C. 5	3.8	39.4
8	,,	,,	,,	,,	D. 6	4.7	32.3
9	,,	,,	,,	,,	E. 7	5.5	28.7
10	,,	,,	,,	,,	F. 8	6.6	25.0
11	,,	,,	,,	,,	G. 9	7.7	22.0
12	,,	,,	,,	,,	H. 10	8.6	20.0
13	,,	,,	,,	Single	C. 5	4.1	37.0
14	,,	,,	,,	,,	D. 6	5.2	31.8
15	,,	,,	,,	,,	E. 7	5.6	27.5
16	,,	,,	,,	,,	F. 8	7.7	24.4
17	,,	,,	,,	,,	G. 9	8.1	22.0
18	,,	,,	,,	,,	H. 10	9.3	19.5
19	,,	300	,,	,,	D. 6	5.3	31.3
20	,,	400	,,	,,	,,	5.7	31 2
21	,,	300	,	Double	,,	5.1	32.4
22	,,	400	,,	,,	,,	5.1	32.0
23	,,	300	White	Single	,,	6.1	30.9
24	,,	400	,,	,,	,,	6.1	30.0
25	,,	300	,,	Double	,,	5.7	31,3
26	,,	400	,,	,,	,,	5.9	31.1
27	,,	200	,,	Single	C. 5	5.2	35.1
28	,,	,,	,,	,,	D. 6	6.3	29.7
29	,,	,,	,,	,,	E. 7	6.9	26.3
30	,,	,,	,,	,,	F. 8	7.8	23.8
31	,,	,,	,,	,,	G. 9	8.8	21.6
32	,,	,,	,,	,,	H. 10	9.8	19.4
33	Cotton 16/48 salmon ply.	392	White	Single	C. 5	4.9	37.6
34	,,	,,	,,	,,	D. 6	5.8	33.0
35	,,	,,	,,	,,	E. 7	6.8	28.4
36	,,	,,	,,	,,	F. 8	7.8	25.3
37	,,	,,	,,	,,	G. 9	8.6	23.2
38	,,	,,	,,	,,	H. 10	9.6	20.7
39	Cotton 16/24 salmon ply.	800	,,	,,	C. 5	4.9	40.0
40	,,	,,	,,	,,	D. 6	5:8	34.0
41	,,	,,	,,	,,	E. 7	6.7	29.3
42	,,	,,	,,	,,	F. 8	7.6	26.0
43	,,	,,	,,	,,	G. 9	8.5	23.2
44	,,	,,	,,	,,	H. 10	9.5	20.9
45	16/18 Cotton salmon	1200	,,	,,	C. 5	5.3	37.5
46	,,	,,	,,	,,	D. 6	6.2	31.8
47	,,	,,	,,	,,	E. 7	7.1	27.8
48	,,	,,	,,	,,	F. 8	8.0	24.7
49	,,	,,	,,	,,	G. 9	9.0	22.1
50	,,	,,	,,	,,	H. 10	10.0	20.0
51	16/12 Cotton salmon	1680	,,	,,	C. 5	5.4	36.8
52	,,	,,	,,	,,	D. 6	6.4	31.6
53	,,	,,	,,	,,	E. 7	7.3	27.3
54	,,	,,	,,	,,	F. 8	8.1	24.4
55	,,	,,	,,	,,	G. 9	9.1	21.7
56	,,	,,	,,	,,	H. 10	10.2	18.6

to net. For instance, if a new codend is fitted and a heavy weight is taken with the first haul, apparently the knots will be pulled tight before the main shrinkage of the material has occurred. On the other hand, if a light catch is taken, the main shrinkage will take place before the knots are eventually pulled tight. Certainly, whatever the reason may be, it has been noticed by certain skippers that heavy catches in the early hauls mean a larger meshed codend. These variations in the sizes of meshes make it necessary for experiments to be carried out on a large scale so that several nets of the same mesh may be tested.

In order to make it possible for himself and other workers to co-ordinate results, the writer has endeavoured to produce a general table (Table I) showing the sizes of meshes produced when different spools and different materials are used. It must, however, be remembered that this table is compiled by the writer from his own personal measurements and subject to his personal bias, and that other workers might get different results. The spools used were of 5, 6, 7, 8, 9, 10 cm. circumference respectively, and the table shows the following data for *new unused mesh:* —

Column I is the serial number of the sample, the originals of which are filed at the Fisheries Laboratory; column II gives the material of which the net sample was made; column III shows the calibre of the material as represented by the number of metres per kilo; column IV shows whether the material was dressed or undressed; column V whether double or single; column VI gives the circumference of the spool in cm.; column VII the maximum internal length of the mesh when stretched as tightly as possible fore and aft; column VIII shows the number of rows per metre.

A table such as this should enable workers to

co-ordinate their results with those of others and enable them to relate their experimental meshes with those used in commercial practice. For instance, the mesh principally tested by Davis (6a, 6c) with a view to saving haddock and hake is sample 6 (10 cm. spool) and this would appear to agree closely with Bowman's 3½″ mesh.

The normal British mesh used by steam trawlers for the North Sea (1932) appears to be something ranging from samples 3 to 4, and the mesh used by British smacks would appear to be between samples 14 and 15.[1]) One has no information as to what the meshes referred to by Borowik as 30, 40 etc. mm. mesh actually represent in sizes, but the writer is inclined to guess that a 30 mm. mesh would correspond to samples 34, 40, 46 or 51.

The data received from various countries as to the size of mesh used in commercial practice show that, with few exceptions, the meshes used correspond to sample 4 (double twine) or 30 (single twine). The main exceptions are to be found in the German and Danish plaice vessels, and the herring trawlers of all countries. The German steam and cutter trawlers use a mesh roughly corresponding to samples 6 or 32 respectively, i. e. of the same lumen as the mesh suggested by the writer for sparing round fish. The Danes in their plaice seines use a mesh that is even larger than No. 6, having a maximum extended length of 10.5 cm. and is probably made on a 11 cm. spool. Furthermore, this net is made of light cotton, and is therefore probably extremely undestructive to small fish.

The herring trawlers of all countries, on the other hand, use extremely small mesh which, when of double twine, corresponds roughly to sample No. 1.

In this connection, it is worth noticing that Todd (16) having compared his results with those of four previous workers, states, "It will be seen from the above table that the results of the various investigators do not invariably correspond ... it is thus obvious that many more hauls are needed with codends of various mesh before the relation between sizes of mesh and proportion of fish escaping, can be definitely stated".

Experimental Results.

The most important pre-war work on the subject of mesh is Todd's paper. This worker took large series of hauls of otter and beam trawl, braided of the same meshes as were in general use by English vessels at the time the data were collected (1906—1908). Todd covered different parts of the net, i. e. the square, baitings and codend, with fine meshed net in order to find out through which portion of the net most fish escaped. He found that the codend released the majority of fish. The present writer is, however, somewhat doubtful whether covering large portions of the net other than the codend is likely to produce true results of the actual escapes of fish. It appears to him that possible sources of error that may occur through the use of covers are liable to increase with the size of the cover used.

The main results produced by Todd as regards the escapes of fish through the codend meshes are shown in the following table. The mesh of the otter trawl appears to coincide with sample 4 and that of the beam trawl with sample 15.

	Beam Trawl released		
	75%	50%	25%
Plaice	9.1 cm.	10.6 cm.	11.6 cm.
Dab	12.2 cm.	17.7 cm.	19.3 cm.
Haddock	—	—	—
Whiting	11.1 cm.	12.1 cm.	12.9 cm.

	Otter Trawl released		
	75%	50%	25%
Plaice	—	—	—
Dab	18.0 cm.	19.9 cm.	22.1 cm.
Haddock	17.5 cm.	18.9 cm.	19.8 cm.
Whiting	12.0 cm.	13.9 cm.	14.9 cm.

In one of Todd's beam trawl experiments, not included in the above table, the codend was supported by a single hoop, and in this case apparently the selection was somewhat sharper (4b).

Davis (6) produced data for haddock and hake in which he showed that 10 cm. mesh, i. e. sample 6, released 75 % of haddock at roughly 21.5 cm., 50 % at 23.7 cm. and 25 % at 26 cm. He also showed that the same mesh released 75 % of hake at 22 cm., 50 % at 26 cm. and 25 % at 29 cm. The writer has now in his possession further data, not yet published, which, including the data just mentioned above, show the results summarised in the following table:—

This shows that for haddock practically the whole of the 0-group and a considerable proportion of the I-group escape, while in the case of the hake, practically all the II-group and a large proportion of the III-group are released. No important saving of plaice is produced; a considerable quantity of small dabs is released, and practically no herring are retained.

The normal codend mesh for the North Sea (1932) appears to release 75 % of haddock at about 18 cm., 50 % at about 19 cm. and 25 % at about 20 cm. and none of 21 cm. or over. The

[1]) The minimum mesh imposed by Order under the Sea-Fishing Industry Act (1933) lies between samples 4 and 5 (double twine).

Species	Length at which 75% are released	Length at which 50% are released	Length at which 25% are released	Efficiency [1]	Less than 1% released	Largest fish released	No. of observations (fish)
Haddock	19.0	22.5[2]	25.2	72.4	33 cm.	36 cm.	51,546
Cod	19.7	22.8	24.2	79.1	28 cm.	27 cm.	1,086
Hake	24.0	28.1	31.0	75.1	43 cm.	45 cm.	11,863
Herring	24.3	29.9	—	—	—	—	7,857
Whiting	24.1	27.0	30.6	75.9	35 cm.	34 cm.	4,530
Plaice	14.6	16.2	17.4	82.7	19 cm.	22 cm.	36,201
Dab	17.0	18.3	19.9	84.2	19 cm.	19 cm.	2,403

[1]) See (6). P 298.

[2]) Further treatment of the fenal data indicates that this length should be 24 cm. +.

results appear to fit extremely well with T o d d's original figures. For hake, the commercial codend appears to release 75 % at just over 16 cm., 50 % at 20—21 cm. and 25 % at 22 cm. None is released at 30 cm. or over.

At the present time, certain vessels sailing from Fleetwood are experimentally fitting codends of the 10 cm. mesh, and it is hoped that in due course data will be available as to actual results of commercial fishing with these codends.

B o w m a n (3a) shows that for a normal otter trawl of 3″ to 3¼″ mesh, i. e. samples 4 to 5, 75 % of haddock are released at 18 cm., 50 % at 20 cm., 25 % at 22 cm. B o w m a n also carried out a series of experiments with an otter trawl with codends of (a) 2¼″ to 2½″ mesh, i. e. samples 3 to 4, (b) 3″ to 3¼″ mesh, i. e. samples 4 to 5, and (c) 3″ to 3½″ mesh, i. e. samples 4 to 6. Preliminary cover experiments show that the smallest haddock captured are by (a) 17 cm., (b) 19 cm., (c) 20 cm. B o w m a n, in this experiment, shows that for every 1,000 haddock between the sizes of 25 and 30 cm. captured with (a) codend, 2226 haddock less than 25 cm. were also taken, for (b) codend 754 and (c) codend 290. Thus a small increase in the size of the codend meshes permitted the escape of large numbers of small haddock under 25 cm. in length.

W o l l a s t o n, (4d) working in inshore waters, on the Devon coast, shows by means of covered net, trouser trawl and alternating haul methods, the results of the use of meshes of 3″ and 3½″ as opposed to the usual 2¼″ meshes. These 3″ and 3½″ meshes probably correspond to samples 36 and 38. It appears that both meshes would spare considerable and useful numbers of plaice and dabs, but that the 3½″ would release so many marketable soles that it would more than counteract the number of plaice and dabs released. This worker recommends the 3″ mesh for inshore work, simply because, although not so efficient as the 3½″ as a sparer of plaice, it would do less damage to the interests of the sole fisherman. The critical point for plaice was about 15.8 cm. for the 3″ mesh while at Poole it was about 19.8 cm. and at Beer 18.9 cm. for the 3½″. For dabs the size was, of course, somewhat smaller. As regards soles, it is emphasized that the 3″ mesh appears actually to catch absolutely greater numbers and therefore a considerably greater weight of the larger sizes of soles. The research samples of B o r o w i k and B o w m a n both appear to show that, with the increase in the size of mesh, there is a greater absolute number of the larger sizes of fish caught.

B o r o w i k (2), after an extremely careful series of experiments shows that there is a definite relation between the sizes of various meshes used and flat fish caught. Furthermore, by means of parallel hauls and cover net experiments, he is able to show that considerable numbers of fish escape from the front, side and underside of the net, the latter being especially important for the smaller sizes of fish. In general, B o r o w i k comes to the conclusion that the 30 mm. mesh is a destructive instrument, whereas, if the size limit is of 18 cm., the 43 mm. mesh would be an effective saving gear. The 45 mm. mesh would be effective with a size limit of 20 cm. but owing to the scarcity of fish of this size and over, there would be grave practical difficulties in the way of either the imposition of the size limit or the use of the mesh.

Two gears have received a great deal of attention: The Ridderstad trawl (11 and 13) and the Gelder trawl (15, 17). Tests of the Ridderstad gear have been carried out by B ü c k m a n n (5), D a v i s (6b), N a v a r r o and C u e s t a (10). The experiments of B ü c k m a n n were on far the most comprehensive scale, and can be considered a true test of the gear. For various reasons, B ü c k m a n n concludes that the Ridderstad gear is neither an effective savings gear nor an efficient fishing gear.

With regard to the Gelder gear, T e s c h certainly obtains clear-cut results and the net appears for plaice and dabs to produce a clear line of demarcation between fish released and retained between 17 cm. and 18 cm. Whiting escape in large quantities, and there are no data on soles. D a v i s's test of this gear showed that if the Gelder framework was used with the normal

"double" 10 cm. mesh with which the main portion of his experiments were carried out, the selection was far blunter than with the normal net. Wollaston (4b) showed the standard Gelder net, with the meshes braided as in the original patent, to have a selection rather sharper than than of the ordinary trawl but shows this to be equally true for a codend distended with a single hoop. The writer here repeats his personal opinion on the subject of the Ridderstad and Gelder gears:—

Ridderstad. The narrow throat of the savings part does not allow of a free flow of fish into the codend and would be liable to be choked by large fish, especially if taken in quantity. The mending of the savings panels would also be a matter of difficulty. It is considered that this conclusion is confirmed by Bückmann's careful experiments where it is noted that an accumulation of fish occurs at the panels.

Gelder. The apparatus is combersome to handle and there is a tendency for the trawl net when fitted with it to become split with abnormal frequency.

General Conclusions.

1. It can be considered proved that the size of fish of each species retained and released is a function of the size of the mesh, but there is a general agreement among various workers that other factors such as speed of towing and quantity of fish on the ground may also affect the question.

2. Since it has been proved that fish are released when the net is being towed, it may be assumed that the fish that escape through the meshes are saved for future capture at a larger size.

3. It appears that a mesh made on a 10 cm. spool, if of double manilla trawl twine, or on spools of 8 to 9 cm., if made of lighter single material, would release considerable quantities of undersized haddock or hake, and would make no important difference to the catch of large soles or other flat fish.

4. Such a mesh would fail to capture the bulk of herring obtained by herring trawlers, as would the present normal whitefish mesh.

5. Owing to the release of marketable soles and round fish, it would appear useless to attempt to devise a mesh that would save other flat fish just below marketable size, say 20—25 cm.

6. There appears to be a general tendency for the loss of small fish to be compensated for by an increase in the absolute numbers of fish caught by the larger meshes.

7. Although small plaice are not released in any quantities, by enlarged trawl meshes, considerable numbers of small dabs escape. This is certainly an excellent point as regards the condition of the catch, since large quantities of dabs in the trawl net not only rub and spoil the condition of the plaice but they cause considerable extra labour in sorting. Also, of course, considerable numbers of small weevers and scruff will escape.

Note. *This report was originally prepared for, and submitted to, the Southern North Sea Committee at their meeting in 1932. Further data have since been obtained which modify certain of the results given in the table on p. 19; these will shortly be published in a comprehensive report by Mr. Davis in "Fishery Investigations".*

Selected List of Literature.

1. Baranov, T.
   Quoted in 2.
2.[1]) Borowik, J.
   (a) "On what does the catch of undersized fish depend?" Journ. du Cons. Vol. V, No. 2, 1930.
   (b) "On what depends the catch of undersized fish?" (First Report on the Polish research on savings Trawls). MS. 1930.
   (c) "Etudes concernant l'influence des engins sur la composition de la pêche." Prace dzialu ekonomji i organizacji rubaxtwa panstwowegs institutu naukowego gosp. Wiejskiego Nr. 45, Bydgoszcz, 1931.
3. Bowman, A.
   (a) "General considerations. The qualitative effect of different fishing gears on the stock of marketable species." Rapp. et Proc.-Verb., Vol. LII, paper II, 1928.
   (b) "The saving effect of an increase in the size of the codend meshes on the haddock of unmarketable sizes." MS. 1931.
4. Buchanan-Wollaston, H. J.
   (a) "On the selective action of a trawl net with some remarks on the selective action of drift nets." Journ. du Cons., Vol. II, No. 3, 1927.
   (b) "The selective action of the Gelder Codend and that of other codends compared." Journ. du Cons., Vol. IV, No. 3, 1929.
   (c) "A fallacious method of estimating selective action." MS. 1930.
   (d) Fishery Investigations, Ser. II, Vol. XIII, No. 1, 1933.
5. Bückmann, A.
   (a) "Bericht über Versuche mit dem schwedischen Schontrawl auf den Jungschollengründen der Deutschen Bucht." Journ. du Cons., Vol. VI, No. 1, 1931.
   (b) "Deutsche Schontrawlversuche." MS. 1930.
6. Davis, F. M.
   (a) "Preliminary note on experimental trawling with codend meshes of different sizes." Journ. du Cons., Vol. IV, No. 3, 1929.
   (b) "Further data on the releasing power of meshes of various sizes." MS. 1930.
   (c) Data for future publication.
7. Fulton, T. W.
   Quoted in 15.

[1]) 2a, 2b and 2c all refer to the same data. 2c is in Polish and is the only one containing graphs of the data.

8. Gilson, G.
Quoted in 15.
9. Heincke, F.
Quoted in 15.
10. Navarro, F. de P., and Cuesta, G.
(a) "Primeros assayos del 'savings trawl' sueco en Espãna." Notas y Resúmenes, Series II, Numero 17.
Cuesta, G.
(b) "Premières expériences avec saving trawl en Espagne." MS. 1930.
11. Petterson, O.
"The Swedish saving trawl." Svenska Hydrografisk-Biologiska Kommissionens Skrifter, VI, 1925.
12. Redeke, H. C.
Quoted in 15.
13. Ridderstad, G.
"A new construction of trawl net intended to spare undersized fish." Ur Svenska Hydrografisk-Biologiska Kommissionens Skrifter, VI, 1915.
14. Santamaria, B. R.
"Diccionario de la pesca." Madrid, 1911.
15. Tesch, J. J.
(a) "First results obtained with the Gelder Saving trawl." MS. 1930.
(b) "Report of experimenttal fishing with the 'Saving trawl' Gelder on Board SS. YM. 101 'Gerbig' from 22nd—29th May, 1929." MS. 1930.
16. Todd, R. A.
"Covered net experiments" Internat. Invest. M. B. A. Rep. III, 1906—8 (1911).
17. Anon.
"The Savings Trawl." Amsterdam 1929.

APPENDIX C.

A Mesh Experiment Indicating that Small Fish Escape while the Trawl is being towed.

By

F. M. Davis.

Fisheries Laboratory, Lowestoft.

Introduction.

Throughout the extensive period during which experiments have been carried out on the saving effect on small fish poduced by enlarging the mesh of trawls, especially those in the codend, workers have found that a considerable body of opinion in the fishing industry argues that the meshes of a trawl including those of the codend, are pulled tight when the net is being towed, thus forming an impervious bag through which fish cannot be released until the way is off the ship and the meshes open up when the net is being hauled. Those holding this view naturally consider that an increase in the size of meshes would be entirely useless as a means of sparing the lives of small fish, since those fish that were small enough to pass through the meshes when open would be retained by them when pulled tight and closed through towing. They would, therefore, be killed or injured before being released at the end of the tow.

It is a strange circumstance that no attempt appears to have been made to solve this admittedly difficult problem, for it is obvious that if the opinion outlined above were proved correct, it would have been entirely useless to pass legislation fixing a minimum size of mesh. The present writer, therefore, considered the question as to whether fish did or did not escape through the codend meshes when the net was being towed, of such fundamental importance, that he instituted experiments designed to solve the problem, and he has been able to show that the greater part of the fish that escape through the meshes of the codend, do so *when the net is being towed, and before it is hauled.*

Methods.

The general principle of the experiment was quite simple, but the actual details of the crucial part of the apparatus, the "throttle retainer", caused considerable difficulty. After several preliminary attempts, Mr. H. H. Goodchild of the Ministry's scientific staff was eventually able to design a practical pattern, which led to the success of the experiment (see page 26). The general scheme of operations was a follows (see Fig. 1).

The codend was fitted with a covering bag of small mesh of the usual design[1]) which retained all fish that passed through the meshes of the codend. This covering bag was fitted with a "throttling noose" actuated by a heavy weight. This throttling noose was in such a position that the portion of the covering bag behind it was behind the codend and the portion in front of it was level with the codend, i. e. when constricted, it cut off a bag into which no further fish could pass, either from its front portion or through the codend meshes. When the net was shot a bight of the throttling line was secured to a special "retainer" or "release" attached to the codend in such a way that the strain of the weight was taken off the throttling noose and supported by the retainer. Thus the covering bag opened up in a normal manner and was free to receive and retain all fish that passed through the meshes of the codend. The retainer also acted as an attachment for a float which in its turn was connected by a length of trawl twine to a spring balance on board the vessel.

In actual practice the retainer was attached to

[1]) i. e. supported on hoops. See Davis, F. M., Journ. du Cons. Vol. IV., No. 3, 1929.

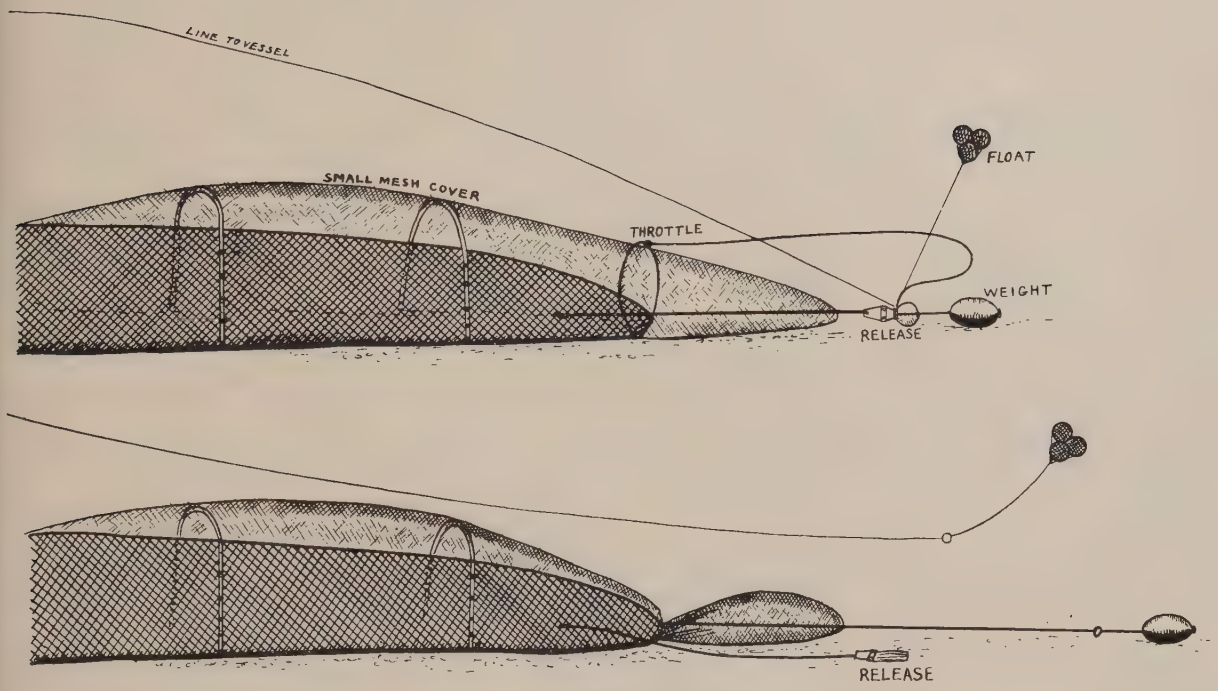


Fig. 1.

the codend and protected by an extension of the false belly or rubber, but, for the sake of clearness, these are not shown in the figure. The weight used in this experiment was just over 60 lbs.

The retainer was so designed that, after a certain period, it released the bight of the throttling line and the float. This immediately produced two results. Firstly the strain of the weight was taken, via the throttling line, on to the throttling noose and thus the latter was pulled tight, and constricted the cover. Secondly the float was released and rose to the surface, and at the same time produced suddenly an extra strain on the spring balance, which warned observers to check visually the fact that the float and consequently the weight had been released. (Details of construction of the retainer are given in the Note printed below on p. 26, and in Fig. 2).

This meant that the trawl was now being towed with no possibility of any fish being able to pass into the hinder end of the covering bag. It also meant that this fact had immediately been indicated to the observers on the vessel.

It is obvious that at this time any fish in the hinder portion of the cover must have arrived there before the constriction occurred and while the net was being towed, while those found in front of the constriction can be assumed to have passed through the net during hauling (subject to a correction mentioned below).

The net was then hauled and the number of fish in the covering bag both in front of and in rear of the constriction were counted and formed the data for the experiment.

Results.

After preliminary experiments, i. e. tests of different types of apparatus, had been carried out, a voyage (Dec. 9th—12th, 1931) was undertaken with the final form of apparatus.

From the start let it be clearly understood, that even in its final form the apparatus did not work on all occasions. "Jams" often occurred which prevented the weight being released so that the net was eventually hauled with the covering bag still open. At other times the action was so long delayed, that the covering bag was burst when being hauled inboard, owing to the weight of fish in it. However, six successful hauls were carried out in all, i. e. hauls where the throttling apparatus worked. In five of these cases the float, when released, duly caused the spring balance to "kick" so that the trawl was hauled soon afterwards. In the sixth case (haul No. 4), however, no kick of the spring balance was observed, consequently the float was probably not observed until some time, possibly an hour, after it had reached the surface.

T

Showing for each station the number of fish found in

A Number in
B Number be

	Station 1					Station 2					Station 3				
	A	B	A+B	$\frac{B}{A+B}$ %	Raised %	A	B	A+B	$\frac{B}{A+B}$ %	Raised %	A	B	A+B	$\frac{B}{A+B}$ %	Rais %
Whiting	157	1799	1956	92.0	95.5	124	1242	1366	90.9	93.7	331	2435	2766	88.0	93
Dab	82	149	231	64.5	67.0	131	464	595	78.0	80.4	513	2580	3093	83.4	88
Weaver	4	48	52	92.3	95.8	96	555	651	85.3	87.9	3	91	94	96.8	100
Cod	3	6	9	66.7	69.3		3	3	100.0	100.0					
Plaice		5	5	100.0	100.0										
Sole		2	2	100.0	100.0	2		2	0.0	0.0	1		1	0.0	0
Solenette	4	9	13	69.2	71.9		4	4	100.0	100.0	5	19	24	79.2	84
Sprat	33	24	57	42.1	43.7	10		10	0.0	0.0	9	14	23	60.9	64
Scaldback	2	18	20	90.0	93.5		3	3	100.0	100.0					
Dragonet						1		1	0.0	0.0					
Gurnard							3	3	100.0	100.0		1	1	100.0	100
Horse Mackerel						2		2	0.0	0.0					
Herring															
Mesh	3½"					3½"					3½"				
Total duration of haul	135 mins.					170 mins.					170 mins.				
Interval between throttling and hauling	5 „					5 „					10 „				
Raising factor	135/130					170/165					170/160				

For hauls 4, 5 and 7 a normal "2½"[1]) mesh was used and for hauls 1, 2 and 3 a larger mesh, "3½".

Table A shows the results obtained for all hauls individually and the total result obtained for all hauls except No. 4, where it is probable that there was a long interval between throttling and hauling. A word of explanation is here necessary as to the meaning of the column entitled "Raised percentage".

It is obvious that unless the net is hauled immediately after the covering bag is throttled, that during the period of towing, between throttling and hauling, a certain number of fish must behave in the same way as before the net was throttled and must pass through the meshes into the covering bag. But since the covering bag is throttled, they must remain in front of the noose, instead of passing it as they would were the cover unconstricted at this point. Consequently all the numbers in front of the noose are maximal and those behind it are minimal when considered in relation to the catch in the codend, which has been fishing during the whole period of the haul. A rough and ready correction has been used, namely the raising of the actual percentage by

$$\frac{\text{Total duration of haul.}}{\text{Duration of haul up to time of throttling.}}$$

The raising factor is shown under each station.

There is little need to remark on the results. For the three commonest species dealt with during the experiment, i. e. whiting, dabs and weavers, it will be seen that (exclusive of haul 4) the proportion released during towing expressed as a percentage of the total released during towing and hauling is extremely high.

e. g.	Actual	Raised percentage
Whiting	87.0	90.9
Weaver	86.0	89.8
Dab	76.5	79.9

The variation between hauls appears not to be unreasonably great.

[1]) 2½" from knot to knot.

nd cover in front of and behind the throttling noose.

ing noose.

ing noose.

Station 4				Station 5					Station 7				All Stations exclusive of 4				
A	B	A+B	$\frac{B}{A+B}$ %	A	B	A+B	$\frac{B}{A+B}$ %	Raised %	A	B	A+B	$\frac{B}{A+B}$ %	A	B	A+B	$\frac{B}{A+B}$ %	Raised %
54	728	1182	61.6	289	1765	2054	85.9	90.0	307	874	1181	74.0	1208	8115	9323	87.0	90.9
77	176	253	69.6	39	70	109	64.2	67.3	304	220	524	42.0	1069	3483	4552	76.5	79.9
50	78	138	56.5	25	111	136	81.6	85.5	7	22	29	75.9	135	827	962	86.0	89.8
3	1	4	25.0	2	4	6	66.7	69.9					5	13	18	72.2	75.4
														5	5	100.0	100.0
					1	1	100.0	100.0					3	3	6	50.0	52.2
	2	2	100.0	2	4	6	66.7	69.9	9	6	15	40.0	20	42	62	67.7	70.7
													52	38	90	42.2	44.1
	2	2	100.0						4		4	0.0	6	21	27	77.8	81.3
1	4	5	80.0	1	5	6	83.3	87.3					2	5	7	71.4	74.6
					2	2	100.0	100.0	2		2	0.0	2	6	8	75.0	78.3
1		1	0.0		3	3	100.0	100.0					2	3	5	60.0	62.7
	1	1	100.0		1	1	100.0	100.0						1	1	100.0	100.0
2½″				2½″					2½″				—				
0 mins.				110 mins.					195 mins.				—				
known				5 „ 110/105					none —				— 585/560				

The experiments took place in the neighbourhood of the Haaks Lightvessel, and the catches were, as can be seen, very small. It might, therefore, be argued that the experiment is unconvincing since it only took place under conditions of low catches and little strain on the net meshes. It must, however, be remembered that if, when fishing on heavily populated grounds, the meshes gradually become blocked, a considerable amount of escapes would take place in the earlier stages of the hauls. This in itself would allow a considerable saving of fish life. Further it must be remembered that the escape of the earliest caught small fish would postpone any possible blockage of the meshes.

Throughout the experiment observations were made on the condition of the fish in the cover. Although the results cannot be quantitatively stated, it was obvious that considerable numbers of the fish in the covering bag were undamaged and "strong alive". It is only to be expected, of course, that fish that have been in the covering bag for some time would be dead or moribund as in the codend proper. However, in actual commercial fishing operations there would be no covering bag to retain the escaped fish and these would pass into the sea in a strong condition and would survive.

The experiment at any rate demonstrates that under conditions of low population where fish can be released through the meshes, the majority escape while the net is being towed. This, in the writer's opinion, demonstrates the practical utility of enlarging mesh as a means of saving undersized fish.

Summary.

The codend of a trawl was fitted with a covering bag of fine meshed net. This bag was so designed that after a certain time, it became throttled and its rear portion could no longer receive fish that passed through the codend. The fact that the bag had been throttled was immediately indicated mechanically to the observers and the net was hauled. It was found that, during the hauls comprising the experiment, out of the total number of fish released 91 % of the whiting, 90 % of weavers, and 80 % of dabs were found to have passed through the mesh of the codend during the period of towing.

Note on the Construction of the Retainer.

The final form of retainer perfected by Mr. Goodchild and used in the experiment, was designed to overcome the difficulty experienced with the original type, which was made of metal, and liable to jam owing to sand getting between the sliding parts.

The present pattern, Fig. 2, consists simply of a strong porous bag containing sodium thiosulphate (hypo) crystals. The method of using is as follows. The requisite amount of crystals, about 500 cm.^{3}, is placed in the bag, and after the two metal rings — connected to the throttle line and float line respectively — have been slipped over the mouth of the bag, it is clamped on to the brass towing clamp.

The direct pull of the iron weight, which operates the throttle, is taken by the throttle release until the crystals have dissolved, when the rings are able to slip free over the bag and the iron weight operates direct on the throttle line, and closes the throttling portion of the net.

The second ring, that is released simultaneously, is connected to a float consisting of three glass fishing floats painted white. A light line also connects this float to a spring balance on the towing vessel, as described above. If the sea is smooth, the float can also be seen as it tows on the surface after being released from the net.

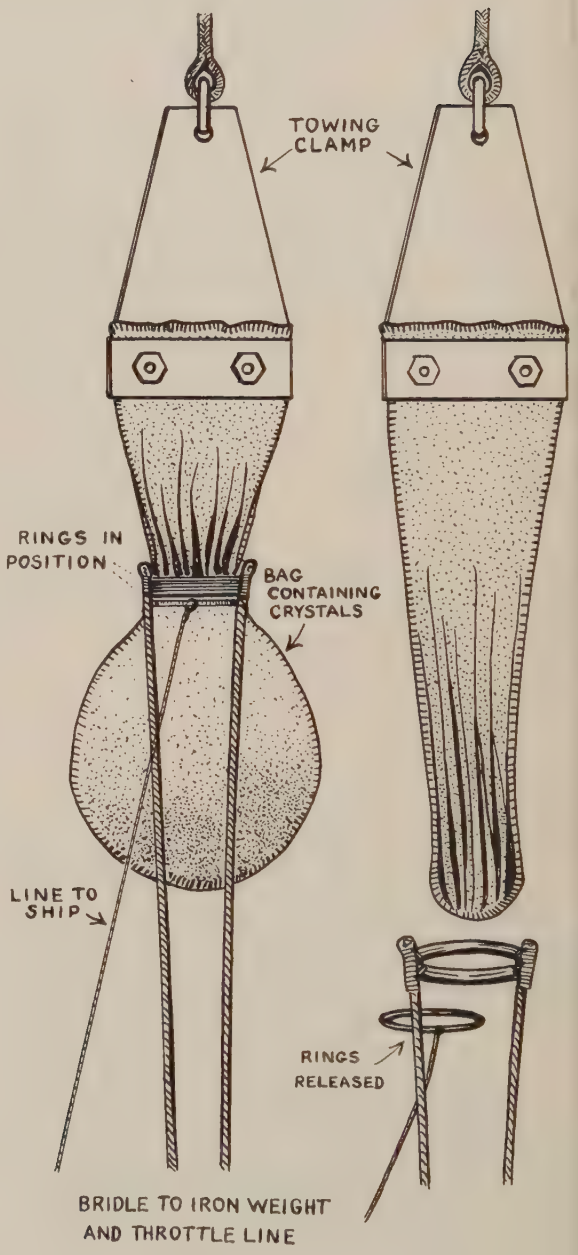


Fig. 2.

APPENDIX D.

Preliminary Note on a Commercial Mesh Experiment.

By

F. M. Davis.

Fisheries Laboratory, Lowestoft.

Introduction.

In accordance with Recommendation 2 of the Combined North Sea and Eastern Channel Committee, (June 23rd, 1932, Rapp. et Proc.-Verb., Vol. LXXXI, p. 48), the Ministry of Agriculture and Fisheries has carried out a mesh experiment under commercial conditions.

This preliminary note describes, in the broadest manner only, the methods used and the results obtained. A further and more detailed account will be produced in due course as one of the Ministry's publications.

The experiment was carried out in co-operation with the firm of G. R. Purdy Trawlers, Ltd. of North Shields, to whom the Ministry's thanks are due.

The general lines of the experiment were as follows: — Two steam trawlers (sister ships) fitted with identical trawls with the exception of the codend (60/60 piece) carried out 12 simultaneous voyages on the same grounds from August 14th to October 16th, 1933. One vessel was fitted with a normal codend as allowed under the Sea Fishing Industry (Fishing Nets) Order, 1933, (i. e. 24 rows per yard when fishing), and the other with one of a larger mesh (about 21 rows per yard when fishing). This corresponds approximately to the H mesh (sample 6 in Table 1 of Appendix B). Careful records of sizes and quantities and prices of each trade category of fish, details of rejected fish, scruff etc., were kept by observers from the Ministry who sailed on each voyage. The vessels always landed on the same day and in adjacent berths, in order to eliminate local market fluctuations.

In order to nullify the effects of possible differences in the fishing capacities of the vessels, or "luck" and experience of the masters and personnel, the vessels changed codends after every voyage, so that each had six voyages with each type of codend.

Methods.

During the voyages the vessels conformed as closely as possible to one another's movements and were not only fishing close together but were in constant touch by wireless telephony.

The normal duration of the hauls was three hours. It must, of course, be remembered, however, that under normal fishing conditions such as obtained during the experiment, "Splits" or torn nets are bound to occur, and therefore it is not strictly correct to say that on each occasion noted as a haul the net was effectively towed for a full three hours. The effect of a split on the quantity of fish taken is for obvious reasons a circumstance that cannot be considered from a quantitative point of view. On certain occasions of course it was obvious that a haul had to be rejected owing to the nature or extent of the damage to the net. However, in all, 411 effective hauls were taken, and consideration of the careful notes made by the observers on the condition of the nets when hauled leads one to presume that the effects of the splits were evenly distributed between the two types of net.

After each haul, the following data were recorded: —

(1) Measurements of the mesh of the codend in rows per yard.
(2) Total quantity of each trade category of each species of marketable fish taken.
(3) Total quantity of fish rejected.
(4) Total quantity of scruff and other rubbish taken.
(5) Measurements of the total haddock catch (or of an adequate sample when the quantities were too large to be dealt with).
(6) Measurements of other fish when time allowed.
(7) Condition, i. e. nature and extent of damage, if any, to net.

After the catch was sold on the market, a certified account was handed to the Ministry by the

owners of the vessels, and this showed the total quantity sold and price realised for each trade category for each species of fish taken.

The following data have been considered in this preliminary report.

(1) Total quantity of each trade category of each species of fish landed.
(2) Total value of each trade category of each species of fish.
(3) The value per unit of quantity taken of each trade category of each species of fish.
(4) (1), (2) and (3) have been reduced to quantity or value per unit time.
(5) Measurements of the haddock taken ("as caught" samples) have been raised so as to give the size distribution of the catch of this species. These measurements have also been roughly converted into relative weights.
(6) The quantities of unmarketable fish and scruff taken by each net have been compared.

The measurements of the remaining species have not yet been considered in detail.

Table I.

North Shields Mesh Experiment. Aug.—Oct. 1933.

Total Fishing Time (12 voyages each):

Normal Mesh 644 hours.
Abnormal Mesh 632 hours.

	Total Value of Catches		Value per 10 hours' fishing		Average Value per Box or per Fish					
	Normal	Abnormal	Normal	Abnormal	Normal			Abnormal		
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	No. of Boxes	£ s. d.		No. of Boxes	£ s. d.	
Haddock										
Large	11 0 0	12 6 3	3 5	3 11	8¾	1 5	1½	9	1 7	4½
Seconds	17 7 3	17 6 9	5 4½	5 6	18	19	3½	17¾	19	6½
Big small	77 0 9	87 6 3	1 3 11	1 7 7½	114¾	13	5	135½	12	10½
Tids	235 2 0	216 14 6	3 13 0	3 8 7	466¾	10	1	442¼	9	9½
					No. of Fish			No. of Fish		
Cod										
Large	205 13 6	218 0 0	3 3 10½	3 9 0	1288	3	2½	1248	3	6
Small	18 19 0	32 12 6	5 10½	10 4	188	2	0	231	2	10
					No. of Boxes			No. of Boxes		
Codling										
Sprag	77 1 9	88 9 6	1 3 11	1 8 0	58¼	1 6	5½	67½	1 6	2½
Medium	87 2 9	77 16 6	1 7 0½	1 4 7½	101¾	17	1½	84	18	6½
Small	64 6 6	63 12 9	1 0 0	1 0 1½	143¼	9	0	141¾	8	11½
Lemon Soles										
Best & best medium	226 12 0	218 18 0	3 10 4½	3 9 3	51½	4 8	0	50¼	4 7	1½
Medium & small medium	42 16 9	41 15 6	13 3	13 2½	13	3 5	11	13½	3 1	10½
Small	16 9 0	14 18 6	5 1	4 8½	8¾	1 17	7	7½	1 19	9½
Unsorted	4 7 0	7 11 0	1 4	2 4½	—			—		
Plaice	62 10 0	59 2 3	19 5	18 8½						
Halibut	8 7 0	4 14 9	2 7	1 6						
Turbot	8 16 3	5 12 6	2 9	1 9½						
Ling	28 6 9	29 12 3	8 9½	9 4½						
Cat Fish	18 14 6	21 3 0	5 10	6 8½						
Skates, Rays, Gurnards and Roker	23 7 9	28 19 3	7 3	9 2						
Saithe (Jacks)	5 18 6	8 12 0	1 10	2 8½						
Whiting	6 1 9	3 7 6	1 10½	1 1						
Witches	5 10 9	6 5 0	1 8½	1 11½						
Monks	10 5 9	9 11 6	3 2½	3 0½						
Other kinds	3 11 0	1 18 0	1 0½	6½						
	1265 8 3	1276 6 0	19 12 9	20 3 10						

Results.

Relative Value of Catches. Table I requires no explanation. Certain obvious results are immediately visible on inspection.

(1) The gross value for the "abnormal" or larger mesh is slightly larger (£ 1276) than is that for the "normal" mesh (£ 1265). Calculated per unit time the value per 10 hours' fishing is £ 19.12.9 for the normal net and £ 20.3.10 for the abnormal, i. e. 11s.1d. in favour of the latter.

The average value per unit of fish when the two trawls are compared shows a certain amount of variation. For example, large and "second" haddock, large and small cod and medium codling, and small lemon soles, show in all cases some, and in many a relatively large, increase in value with the larger mesh. The remainder show a decrease in value which, with the exception of medium and small medium lemon soles, is very small.

As will be shown below, considerable numbers of small fish taken by the normal codend are not taken by the abnormal. In spite of this, however, the above data show that the value of the lost fish is made up.

Relative Size Distribution. Table II shows in columns 2 and 3 the total number of haddock taken at each cm. length for the whole series of voyages (including fish rejected as too small for sale) and this is reduced to catch per 100 hours' fishing in columns 4 and 5. Fig. 1 is a histogram produced from these latter figures and shows that up to 29.5 cm. (11.6 inches) more fish are retained by the normal than by the abnormal mesh, but that above this size the reverse is the case. It should be clearly understood that these are not percentage or relative figures and so it appears that — for the duration of this experiment at least — enlargement of the mesh produced an *absolutely* greater number of the larger sizes than are taken by the smaller mesh.

A rough calculation in terms of weight produces a still more striking result.

In columns 6 and 7 of Table II the number at each cm. length has been multiplied by the cube of the cm. length and this result divided by 19^3. This means that a rough conversion has been made into the relative weights at each cm. length in terms of fish of 19 cm. (the smallest caught). The result is shown graphically in Fig. 2.

Comparison of the relative weights shows that the extra weight of fish of over 29.5 cm. retained by the abnormal mesh is slightly in excess of the weight of fish under 29.5 cm. taken by the normal mesh but released by the abnormal. In this connection it should also be remembered that until the largest categories of fish are reached the value per unit weight of any fish increases with the actual weight.

Table II.

Length in cm.	Total Numbers		Numbers per 100 hours fishing		Relative Weight	
	Normal Mesh	Abnormal Mesh	Normal Mesh	Abnormal Mesh	Normal Mesh	Abnormal Mesh
(1)	(2)	(3)	(4)	(5)	(6)	(7)
19	17	4	3	1	3	1
20	61	9	12	2	14	2
21	183	35	36	7	49	9
22	927	224	180	46	279	71
23	2208	519	429	106	761	188
24	3765	1085	731	221	1473	445
25	4883	2092	948	427	2160	973
26	7142	3849	1387	786	3554	2014
27	10270	7123	1994	1454	5722	4172
28	13144	10023	2552	2046	8168	6548
29	14956	12933	2904	2639	10326	9384
30	13184	12806	2560	2613	10077	10286
31	11389	11741	2211	2396	9603	10407
32	8194	8929	1591	1822	7601	8704
33	5305	6705	1030	1368	5397	7167
34	4010	4899	779	1000	4464	5730
35	2687	3398	522	693	3263	4332
36	2288	2676	444	546	3020	3714
37	1873	2047	364	418	2688	3087
38	1200	1393	233	284	1864	2272
39	946	1320	184	269	1591	2326
40	621	715	121	146	1129	1362
41	470	552	91	113	914	1135
42	342	338	66	69	713	745
43	259	258	50	53	580	614
44	197	207	38	42	472	522
45	114	76	22	16	292	213
46	56	124	11	25	156	355
47	51	45	10	9	151	136
48	55	93	11	19	177	306
49	34	20	7	4	120	69
50	28	11	5	2	91	36
51	15	14	3	3	58	58
52	2	5	0	1	0	20
53	10	2	2	0	43	0
54	9	11	2	2	46	46
55	5	4	1	1	24	24
56	3	1	1	0	26	0
57	5	16	1	3	27	81
58	2	3	0	1	0	28
59	3		1		30	
62	5		1		35	
64	2		0		0	
65	5		1		40	
68		7		1		46
73		1		0		0
Total	110925	96313	21539	19654	87201	87628

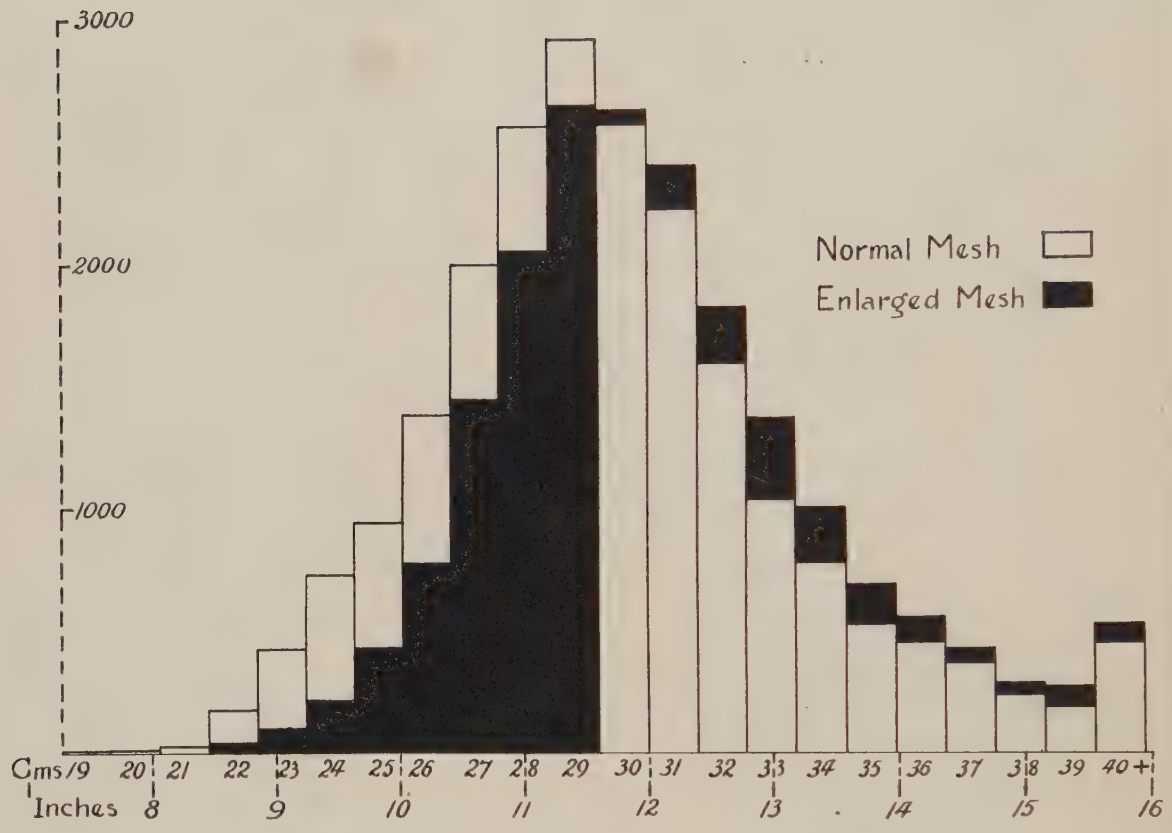


Fig. 1. Commercial Mesh Experiment. Nos. of Haddock taken per 100 hours' fishing.

It should be clearly understood that these calculations both for numbers and for weights refer only to the actual population of fish on which the experiment took place. Naturally, if the numbers of small fish were relatively larger in another population a still larger proportion of small fish would be released and vice versa.

Catch of Useless Material. The total quantities of haddock found too small to be sold and therefore rejected were as follows: —

In the case of the normal mesh, 47 baskets or $7^1/_2$ baskets per 100 hours' fishing.

In the case of the abnormal mesh, 19 baskets or 3 baskets per 100 hours' fishing.

The amount of scruff, i. e. invertebrates, small stones and other rubbish taken, was as follows:—

By the normal mesh, 199 baskets or $30^3/_4$ baskets per 100 hours' fishing.

By the abnormal mesh, 144 baskets or $22^3/_4$ baskets per 100 hours' fishing.

This shows that as regards the population of fish and invertebrates, and the nature of the ground exploited during the experiment, the larger net took 60% less of unmarketable haddock than did the normal. It shows also that it failed to take 26% of the scruff. Both the above circumstances should be important factors affecting the condition and consequent value of the marketable fish retained.

Summary.

Speaking broadly, the experiment indicates (1) that the use of a codend of larger mesh allowed considerably greater numbers of the smaller fish to escape. (2) This fact caused no financial loss to the vessel carrying the larger mesh. The value was mainly made up by the larger numbers of fish of larger sizes taken. The total figures show a somewhat higher value per unit for some species, but the data have not yet been critically analysed to determine whether the differences mean anything.

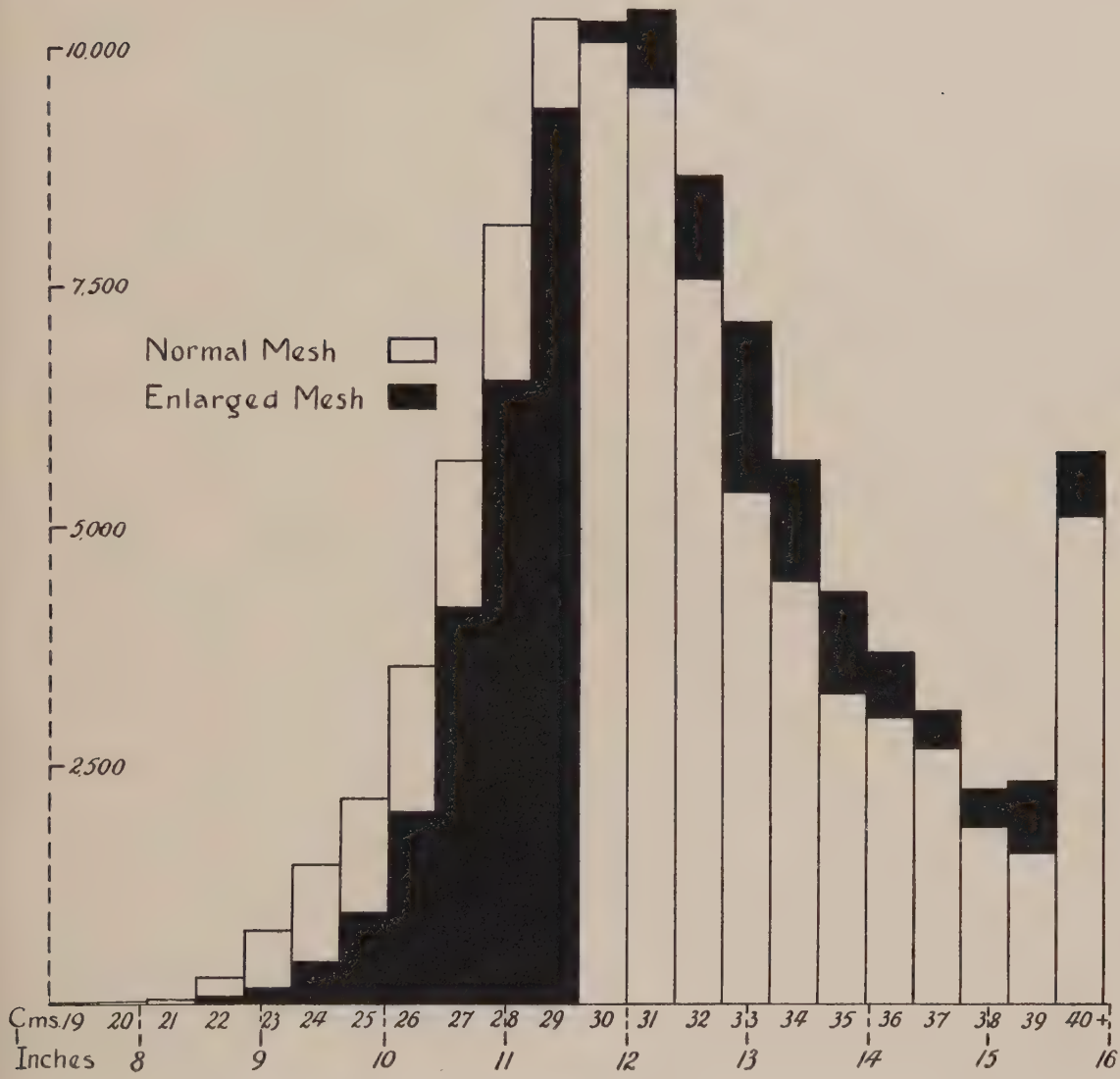


Fig. 2. Commercial Mesh Experiment. Relative Weights of Haddock taken per 100 hours' fishing.

II.

ÜBER EIN MINDESTMASS FÜR DIE SEEZUNGE DER NORDSEE.

VON

A. BÜCKMANN,
HELGOLAND.

AUF der Sitzung des "Combined North Sea and Eastern Channel Committee" der Internationalen Meeresforschung am 10. Mai 1933 wurde ein Mindestmass von wenigstens 23 cm. für die Seezunge empfohlen.

Die Beobachtungen über Biologie und Bestand der Seezunge in der südlichen Nordsee, die im Laufe des letzten Jahrzehnts von der Biologischen Anstalt auf Helgoland bei Gelegenheit der Schollenuntersuchungen gesammelt worden sind, sind vom Verfasser im letzten Jahre bearbeitet worden. Dem soeben abgeschlossenen Manuskript sind folgende Tatsachen zu entnehmen, die für die Beurteilung der vorgeschlagenen Massnahme von Bedeutung sind:

1. Die Seezungenanlandungen aus der Nordsee haben in allen Ländern, für die vollständige statistische Daten vorliegen, gegen die Vorkriegszeit zugenommen. Das ist um so auffallender, als dem keineswegs eine entsprechende Zunahme der Gesamtanlandungen an Grundfischen gegenüber steht. Das zeigt die folgende Übersicht:

Seezungenanlandungen aus der Nordsee.

	England	Holland	Deutschland	Dänemark	Zus.
Mittel 1907/14 in t:	1530	510	106	24	2171
„ 1923/30 „ t:	1779	1750	131	60	3719
Mittel 1923/30 in % von Mittel 07/14: ...	116	343	124	250	171

Gesamtanlandungen von Grundfischen aus der Nordsee.

	England	Holland	Deutschland	Dänemark	Zus.
Mittel 1923/30 in % von Mittel 07/14: ...	79	155	83	230	97

Die deutschen und englischen Gesamtanlandungen sind also zurückgegangen, während die Seezungenanlandungen zunahmen. Die holländischen Seezungenanlandungen haben viel stärker zugenommen als die Gesamtanlandungen von Grundfischen. Nur in Dänemark ist die Zunahme etwa proportional.

2. Die Zunahme der Seezungenanlandungen kann nicht allein auf eine günstigere Beschaffenheit des Seezungenbestandes in den letzten Jahren zurückgeführt werden. Der in der Kriegsschonzeit angehäufte Bestand war schon 1923 im wesentlichen abgefischt. Auch die Fluktuationen können wir nicht für die Verbesserung der Erträge verantwortlich machen. Einmal sind die verglichenen Perioden (je 8 Jahre) so lang, dass der Einfluss der Fluktuationen innerhalb dieser Zeit sich etwa ausgleichen müsste. Zweitens lagen die Anlandungen auch im ungünstigsten Nachkriegsjahr, als nachweislich zwei sehr arme Jahrgänge in dem marktfähigen Bestand enthalten waren, weit über dem Vorkriegsdurchschnitt. Wir müssen also annehmen, dass die Fischerei jetzt mehr auf den Fang von Seezungen ausgeht als früher. Damals war in der Nordsee der Fang von Massenfischen der wichtigste Betrieb. Dieser ist aber jetzt nicht mehr so lohnend, weil die betreffenden Bestände stark abgefischt sind und weil den Massenfischen aus der Nordsee eine schwere Konkurrenz in den Anlandungen billiger Fische von den nördlichen Fangplätzen erwachsen ist. In der Nordsee ist daher der Fang der konkurrenzlosen Qualitätsware, vor allem der Edelfische, heute viel wichtiger als früher.

Der Seezungenbestand wird also jetzt intensiver befischt als in der Vorkriegszeit.

3. Die Seezungenanlandungen aus der Nordsee wiesen in den letzten Jahren ausserordentlich grosse Schwankungen auf. Die Erträge des reichsten Jahres (1929) liegen um 110 % höher als die des ärmsten (1930). *Diese Schwankungen können zum grössten Teil aus den beobachteten Fluktuationen der Jahrgänge erklärt werden.* Daneben haben allerdings besondere Fischereiverhältnisse und die Schädigung des Bestandes durch die grosse Kälte des Winters 1929 offensichtlich eine Rolle gespielt.

4. Die starke Abhängigkeit der Erträge der Fischerei von den Fluktuationen in der Bruterzeugung lässt erkennen, dass ein grosser Teil der Seezungenanlandungen aus jungen Fischen besteht und sich aus nur wenigen Jahresklassen zusammensetzt. Bei den meisten Nutzfischen tritt dieser Zustand erst dann ein, wenn der Bestand an grösseren und älteren Fischen stark abgefischt ist. Bei der Seezunge aber dürfen wir nicht ohne weiteres annehmen, dass das Vorherrschen kleiner Fische einen Mangel an grossen erkennen lässt. Kleine Seezungen waren von jeher ein begehrter Artikel, der z. B. im Holland meist höher bezahlt wird als grössere Fische dieser Art.

5. Bei Untersuchung der Zusammensetzung der Seezungenbevölkerung der Deutschen Bucht zeigt es sich aber, dass der relative Anteil der grossen (über 35 cm. langen) und alten (7 und mehrjährigen) Seezungen von 1920 auf 1924 sehr stark zurückgegangen war. 1928 waren nur noch ganz geringe Mengen solcher Fische vorhanden, und ihr Anteil

am Bestande hält sich seither auf niedrigem Niveau. Der Anteil der Seezungen über 40 cm. war schon 1928 sehr viel niedriger als vor dem Kriege im Jahre 1904, und ist seither nicht gestiegen. *Offensichtlich hat die stärkere Ausnutzung des Seezungenbestandes zu einem Rückgang des Vorrats an grossen Seezungen geführt.* Fluktuationen können diese Entwicklung nicht vortäuschen, weil gegenwärtig die reichsten Jahrgänge der Nachkriegszeit im Alter von 7 und mehr Jahren im wesentlichen zu den grossen Seezungen gerechnet werden müssen.

Auch die Anlandungen zeigen den Rückgang der grossen Seezungen insofern als der Prozentsatz der Marksorte "Gross" abnimmt, der der Sorte klein aber zunimmt.

Seezungenanlandungen aus der Nordsee,
Prozentuale Zusammensetzung nach Marktsorten im Mittel verschiedener Jahre.

Jahre	Deutschland %			England %				Holland %		
	Gross	Mittel	Klein	Gross	Mittel	Klein	Unsort.	Gross	Mittel	Klein
1909/13	64	36		49	24	23	4	33	50	17[1])
1920/24	59	33	8	56	22	17	5	21	59	20[2])
1925/29	37	35	28	33	29	33	5	13	35	52
1930/32	36	28	36	27	29	39	5	9	33	58

[1]) Für 1906/10 nach Redeke.
[2]) Für 1921/24.

In den ersten Nachkriegsjahren ist zwar an sich überall eine Vermehrung des Anteils der grossen Fische zu verzeichnen, doch folgte der Rückgang so schnell, dass im Mittel der Jahre 1920/24 nur bei den englischen Anlandungen eine Verbesserung erkennbar ist.

6. Wenn auch der Seezungenbestand nicht als durch die Fischerei bedroht bezeichnet werden darf — dagegen spricht die Tatsache, dass die Anlandungen gegen die Vorkriegszeit noch gesteigert werden konnten — so ist doch die Wirkung der intensiven Fischerei bereits zu verspüren, und es ist daher an der Zeit, *für eine rationelle Ausnutzung auch dieses Bestandes zu sorgen.*

7. Die Wachstumsgeschwindigkeit der Seezungen erweist sich im grossen ganzen als konstant. Die Längenmittel der Altersgruppen schwanken in unserem Material aus der Periode 1923—1933 innerhalb geringer Grenzen. Bei der geringen Grösse der Proben müssen diese Schwankungen als zufällige Abweichungen aufgefasst werden. Auch liegen die Längenmittel in dem Material von 1920, von 1916 (E. Mohr) und von 1911 (J. J. Tesch) ganz nahe bei denen der späteren Periode. Wir sind daher nicht berechtigt anzunehmen, dass die Wachstumsgeschwindigkeit der Seezunge, wie etwa die der Scholle, abhängig sei von der Dichte der Bevölkerung, was ja bei der Seltenheit der Seezunge ohnehin nicht wahrscheinlich ist. *Mithin kann die nachteilige Wirkung der Vernichtung untermassiger Fische bei der Seezunge nicht durch gesteigertes Wachstum ausgeglichen werden, und die Schonung der untermassigen Seezungen ist daher unter allen Umständen zu erstreben.*

8. Die Vernichtung untermassiger Seezungen ist gegenwärtig sicher sehr bedeutend. Schon die Seezungen des ersten und zweiten Lebensjahres fallen im Wattenmeer und an der Küste in grossen Mengen der Garnelenfischerei zum Opfer. Wulff (in Wulff/Bückmann/Schubert 1932) berechnet, dass in den Gammelanlandungen der deutschen Garnelenfischer in dem Jahre von November 1929 bis Oktober 1930 nicht weniger als 3½ Millionen Seezungen von 3 — ca. 20 cm Länge enthalten waren. Diese Zahl ist sicher zu gering, da er die Anlandungen der Fischerei in Jadebusen nur im Frühjahr, nicht aber im Sommer 1930 berücksichtigen konnte. Der Jadebusen ist aber das Gebiet, in dem der Seezungengehalt der Fänge in der Jahreszeit der Untersuchungen beiweitem am höchsten war. Andererseits gab es im Untersuchungsjahr besonders viele kleine Seezungen, da die Jahrgänge 1929 und 1930 very gleichsweise gut ausgefallen sind. — Dass auch der holländischen und belgischen Garnelenfischerei viele kleine Seezungen zum Opfer fallen, darf angenommen werden. Gilson berechnet 1928 die Zahl der jährlich durch die belgische Küstenfischerei gefangenen kleinen Seezungen auf durchschnittlich 272.000 Stück. Das bezieht sich auf die Zeit vor der Motorisierung der Flotte und vor der Einführung der Gammelanlandung in Belgien. Heute muss die Zahl viel grösser sein.

9. Leider lässt sich der Fang kleiner Seezungen durch die Garnelenfischer nicht vermeiden, da das Verbreitungsgebiet der Seezungen des 1. und 2. Lebensjahres weitgehend mit den Fangplätzen der Garnelenfischer zusammenfällt und die Verwendung weitmaschiger Geräte für diesen Betrieb unmöglich ist. Ebensowenig ist es möglich, die ganz kleinen Seezungen, die mengenmässig einen verschwindend kleinen Bruchteil der Fänge bilden, auszulesen und lebend wieder ins Meer gelangen zu lassen. Erst von einer gewissen Länge an wird es möglich sein, die Seezungen und andere Plattfische aus den Fängen abzusieben. *Ein Anlandeverbot für untermassige Seezungen könnte daher erst von einer Länge von ca. 13 cm. an praktisch durchgeführt werden.* Nur etwa 16 % der von den Garnelenkuttern gelandeten Seezungen überschreiten, nach unseren Messungen zu urteilen, dies Mass.

10. Über die Vernichtung untermassiger Seezungen durch die Hochseefischerei liegen keine Angaben vor. *Diese Vernichtung ist aber bei Verwendung von hinreichend weiten Maschen vermeidbar und könnte durch Bestimmungen über Maschenweite und Anlandungsverbote völlig verhindert*

verden. Über die Fangwirkung von Trawls verschiedener Maschenweite bezüglich der Seezunge hat Buchanan-Wollaston kürzlich einige Daten veröffentlicht. Wir stellten Vergleichsfänge zwischen dem Decksteertnetz und dem Zungentrawl, das die deutschen Hochseekutter verwenden, an. Dies Kuttertrawl hat im Steert eine Maschenweite von 24—25 Knoten je m. bei einfach gestrickten Maschen; mit diesem Gerät wurden in den Vergleichsfängen nur 9 Seezungen von weniger als 26 cm. Länge gefangen, während das engmaschige Decksteertnetz deren 71 fing.

11. Das Zungentrawl der deutschen Kutter ist also weitmaschig genug und fängt nur wenig untermassige Seezungen. Das im Frühjahr benutzte Schollentrawl ist noch viel weitmaschiger und fängt durchaus keine untermassigen Zungen mit. Diese Erwägungen scheinen die Einführung eines Anlandeverbots von Seezungen zwischen 13.0 und 24.0 cm. als Schonmassnahmen, wie sie auch für die Nordseescholle vorgeschlagen werden, zu rechtfertigen.

12. Marktmessungen an Seezungen sind in Deutschland bisher erst in ganz geringem Umfang ausgeführt worden. Sie zeigen, dass in den Anlandungen Seezungen von 21 cm. an vorkommen, jedoch als zufällige Beimengungen in ganz geringer Zahl. Etwas stärker sind die Seezungen von 23 cm. an vertreten. Das untere Längenquartil der Sorte III (klein) liegt erst bei 26.2 cm. Werden sehr viele kleine Seezungen gefangen, wie es im Herbst 1933 der Fall war (starke II-Gruppe), so wird ausnahmsweise eine Sorte IV unterschieden, die ganz innerhalb der Längenvariation der Sorte III liegt und deren kleinere Individuen umfasst. Das untere Quartil dieser Sorte liegt bei 24.0 cm. Bei einem Mindestmass dieser Höhe würde also nur die Anlandung eines unerheblichen Teiles der kleinsten und geringwertigsten Sorte verhindert werden, die nur in einzelnen Jahren Bedeutung hat. *Das Mindestmass von 24 cm. ist demnach für die deutsche Fischerei durchaus tragbar.* Sehr wahrscheinlich gilt das Gleiche auch für die Fischereien der andern Länder.

13. In den ersten Lebensjahren wachsen die Seezungen sehr schnell. Wir beobachteten folgende Längenmittel:

Altersgruppe	Jahreszeit	mittlere Länge in cm. ♂	♀
	Frühjahr	10	10
I	Sommer	16	16
	Herbst	18	18
	Frühjahr	19	19
II	Sommer	22	22
	Herbst	23	24
	Frühjahr	25	27
III	Sommer	26	28
	Herbst	26	29
IV	Frühjahr	28	31

Im Herbst haben die Altersgruppen folgende Gewichtsmittel:

Altersgruppe	Jahreszeit	mittleres Gewicht in g. ♂	♀
I	Herbst	55	54
II	„	109	129
III	„	169	237
IV	„	214	313

Das Mindestmass wird also schnell überschritten. Die Fische, die bei Verwendung weitmaschiger Netze dem Fange entgehen, werden schon wenige Monate später marktfähig und in bedeutend verbesserter Qualität fangbar. Wird eine Seezunge, die infolge der Verwendung weitmaschigerer Netze im Herbst des dritten Lebensjahres dem Fang entgangen war, im Herbst des vierten Lebensjahres erbeutet, so ist ein ♂ im Durchschnitt 60 g. oder 55 %, ein ♀ sogar 108 g. oder 84 % schwerer geworden. Ein Teil der ♀ ist bis zum Herbst des vierten Lebensjahres sogar schon soweit herangewachsen, dass sie zur Sorte II gerechnet werden. Zu dem Gewichtszuwachs kommt dann auf dem deutschen Markt noch der Mehrwert je kg. hinzu.

14. Das Anlandeverbot von 13—24 cm. schützt die I-Gruppe und zum Teil die II-Gruppe. Im Herbst werden die grösseren Individuen der II-Gruppe marktfähig. Die folgende Übersicht zeigt den Prozentsatz der Seezungen, die marktfähig sind, in verschiedenem Lebensalter: (♂ + ♀)

Altersgruppe	Jahreszeit	% marktfähig
I	Herbst	0
	Frühjahr	2
II	Sommer	20
	Herbst	43
	Frühjahr	77
III	Sommer	90
	Herbst	93
IV	Frühjahr	97
	Sommer	100

Das Heranwachsen zur Marktfähigkeit erfolgt zunächst sehr schnell. Der letzte Rest der Untermassigen dagegen wächst nur langsam heran. Es sind dies die kleineren unter den ♂, bei denen das Wachstum viel eher nachlässt als bei den ♀. *Infolge dieses Zurückbleibens eines Teiles der ♂ würde ein erheblich höheres Mindestmass vielleicht minder rationell sein als das vorgeschlagene.*

III.

SOME REMARKS ON MESH WIDTH AND ITS INFLUENCE ON YOUNG FISH.

WITH

ADDENDUM.

BY

Captain THOR IVERSEN, BERGEN.

M. Beaugé[1]) does not believe in the utility of fixing a definite size of mesh for trawls in order to limit the number of young fish in the catch. The essence of his remarks on this question is:

(1) A net with an 8 cm. mesh retains just as many small fish as a net with 4 cm. mesh because "le filet s'étire à la traction."

(2) The small fish that might escape if the meshes happened to open sufficiently, would undoubtedly be so mutilated and damaged that they would not be able to use the opportunity to escape.

(3) If any small fish escape in the disturbance of the water they will probably not survive.

As regards (1) and (2) the expression "le filet s'étire à la traction" I understand as follows:— while hauling the cod-end, meshes will stretch so much in the length direction that the openings will bee too small for small fish to get through.

I haven often noticed, during trawling and fishing with other trawl-like gears, that the mesh, owing to the pressure of water inside the bag, spreads and remains much more open than is anticipated by M. Beaugé. Of course it is not sufficient to give the cod-end a bigger mesh; the net in front of the cod-end must have a mesh in proper relation to that of the cod-end.

My experience is that a big mesh allows more and bigger fish to escape than does a small mesh. Examples from every day practice could be mentioned but this is unnecessary as special experiments with which I have recently been acquainted can be referred to.

In Journal du Conseil, Vol. IV, no. 3, 1929, Mr. F. M. Davis of the Fisheries Laboratory, Lowestoft, gives a paper on experiments with cod-ends fitted with mesh of various dimensions. The results from fishing on the hake-grounds are here given as follows:

(4.2) 6 cm. meshes: released 3.5 % fish (hake) only of 16 cm. All fish of 22 cm. were retained.

(5.8) 8 cm. meshes: released 75 % fish of 17 cm., 50 % of 21 cm., 25 % of 23 cm. All fish of 30 cm. were retained.

(8.5) 10 cm. meshes: released 75 % of 22 cm., 50 % of 26 cm., 25 % of 29 cm. All fish of 41 cm. were retained.

As far as I can judge, the size of mesh mentioned is not quite correct but should be considerably less. Mr. Davis says in the paper that the cod-end was made on spools with a circumference of 6, 8 and 10 cm. which roughly speaking corresponds to a mesh width of 4.2, 5.8 and 8.5 cm. in use. Those figures are given in brackets above.

As regards point (3) I am not able to prove how great viability the small fish possess when escaping through the mesh of the trawl. It is reasonable to believe that the fish which remains in the cod-end during a long period of trawling before finally it escapes through the mesh is hardly able to survive, particularly so when the haul takes place on banks with very sharp sandy bottom. In the North Sea for instance such localities are frequent and hauls of comparatively long time (4 hours or even more) are customary; but conditions are somewhat different if the fish escape after a comparatively short sojourn inside the trawl.

During the winter cruises in the Barents Sea in 1932—33 with the hired trawler "Borgenes" I tried as far as possible to solve this important question about the viability of escaping fish. In the fine meshed net covering part of the cod-end I could survey the small fish caught with this net. When the trawl was hauled with the bag floating on the surface near the ship's side I saw the small fish in the fine meshed bag and was surprised at the vitality shown as well as how little damage thay had suffered. It happened that there was a minor hole in the net and small fish which disappeared through the hole as a rule

[1]) See "Report of Cod Expert Meeting", Note (Rapp. et Proc.-Verb. Vol. LXXXIX, part II, p. 14).

nmediately went towards the bottom full of life. 'n several occasions the fine meshed bag con- ained herring of 13—25 cm. length. The herring oo, although a delicate fish, were surprisingly live and unhurt. Samples have been cured, and ie fish have also given a very good material for cale investigations.

From what I noticed on board the "Borgenes" was convinced that the major part of the catches i the fine meshed bag was viable, and from this oint of view I strongly believe in the utility of ixing a size of mesh for cod-ends.

Our hauls in the Barents Sea usually lasted bout 2 hours (1—3 hours) and were made at epths of 80—100 fathoms. The bottom was sually soft (clay and fine sand). Usually ommercial trawlers make much shorter hauls in ie Barents Sea than in more southern waters, and ieir fishing area has lately been the slope of the anks where previously lines only were used. Many difficulties present themselves in making pecial researches in order to prove that my view f the viability is correct, but I believe that it ay be done and that it should be done, as the hole question of introducing certain mesh widths n trawls, in order to save the young fish, is holly dependent on sush experiments.

In the discussion of mesh width the expres- ions: cm.-length of mesh and knots per m. are ound.

In Norway the only distinction used is knots o the ell as a measure of mesh, and this escription is both more practical and more oncise than length per mesh. In England partly ngth per mesh and partly number of knots to the ard is customary. In the abovementioned note by mt. B e a u g é the distinction cm. per mesh is sed.

In Mr. D a v i s' article in the Journal du Conseil e has treated, amongst other questions, the elation between cm. per mesh and knots to the ard.

As the two expressions have been used alter- atively it is of importance to know what they ean in relation to each other and I have also tried o find out this. The result I have arrived at is ot quite the same as that given by Mr. D a v i s. My measurements concern nets made from new, mpregnated, double, 3ply Manilla twine as usually sed onboard trawlers. Three net samples were ade on spools with 10, 8, and 6 cm. circum- erence respectively. The 10 cm. spool averaged 6.6 knots to the yard and 8.5 cm. mesh. The cm spool — 24.8 knots to the yard and 5.8 cm. esh, while the 6 cm. spool averaged 30.3 knots o the yard and 4.2 cm. mesh. From these data igure 1 has been constructed.

The figure shows the relation between a certain umber of cm. or English inches per mesh (inside easure and stretched) and number of knots per Norwegian ell, per English yard and per meter. Mr. B i r g e r R a s m u s s e n has undertaken the calculation of the curve shown in the figure by the following equation:

$$L = \frac{Y - (I + R\ K/2)\ K/2}{K/2}$$

L = Lumen of stretched mesh.
Y = Yard (91.44 cm.)
I = Reduction per mesh (calculated 0.458 cm.)
R = Increase of reduction per mesh (calculated 0.0902 cm.)
K = Knots per yard

It should be noted that the values shown may vary somewhat. The Manila twine from which trawls are made is comparatively thick and stiff. The twine may also vary in thickness due to uneven spinning. With such material the mesh may easily be uneven through loose or tight braiding. Also the measurements themselves are difficult to get homogeneous, and the numerical value is to a great degree dependant on the amount of stretching of the net during measurements.

The appendix shows the data and the equation used.

Data and Calculation of the Figure

Trawl net made of new waterproofed 3ply twine, doubled.

The calculations are based upon 3 samples of net made on spools of 10 cm., 8 cm. and 6 cm. circumference and of 3ply twine normally used in English trawls. By "lumen" is meant the total length of the lumen of the mesh when stretched to its fullest extent in a fore and aft direction.

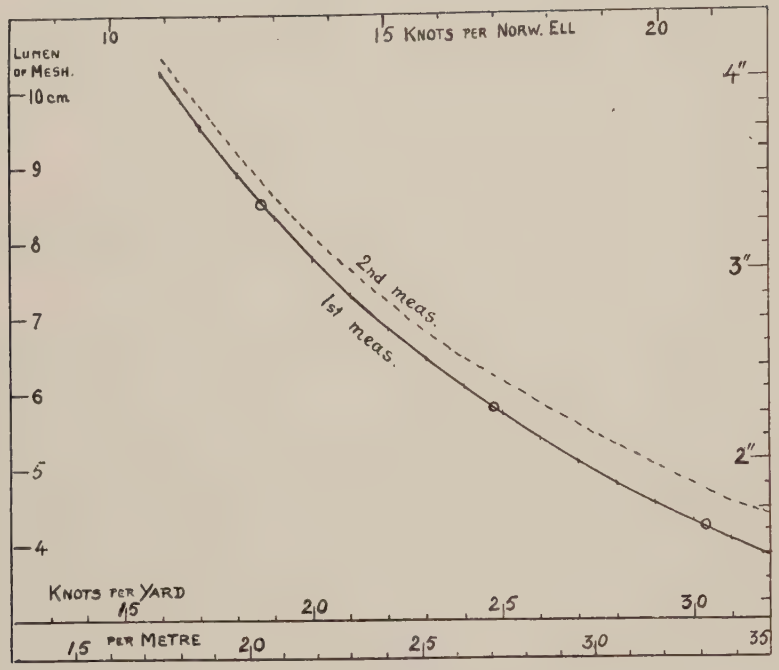
The number of meshes equals half the number of knots.

1) 10 cm. spool averaged 18.65 knots pr. yard. Lumen 8.5 cm.
2) 8 cm. spool averaged 24.80 knots pr. yard. Lumen 5.8 cm.
3) 6 cm. spool averaged 30.30 knots pr. yard. Lumen 4.2 cm.

The figure shows the lumen of the mesh relative to number of knots pr. English yard (91.44 cm.) per Norwegian ell (62.65 cm.) and per meter. The calculation of the points of the curve is based upon the actual measurements mentioned above. The line is drawn through points calculated for the various numbers of knots per yard by the following formula:

$$L = \frac{Y - (I + R\ K/2)\ K/2}{K/2}$$

L = Lumen of stretched mesh.
Y = Yard (91.44 cm.)
I = Reduction pr. mesh (calculated 0.458 cm.)
R = Increase of reduction pr. mesh (calculated 0.0902 cm.)
K = Knots pr. yard.



The Lumen of the Mesh in Ratio to th Number of Knots in Trawl Nets mad of New, Waterproofed, 3-Ply Twine, Doubled.

By reduction per mesh is meant that part of the reduction which is conceived as unaffected by the mesh.

By increase of reduction pr. mesh is meant the extra reduction of lumen produced by the greater resistance of fine meshed nets against stretching.

It must be mentioned that the measurements given are subject to variations. The Manilla twine used in the making of the net is relatively thick and stiff. The twine may also have been unevenly spun and of varying thickness.

In the material used the meshes will easily become uneven by loose or tight braiding. Furthermore it is difficult to get homogeneous measurements. The values obtained depend also upon the degree of stretching of the net while the measurements are being taken.

A second measurement on the net made on the 6 cm. spool gave the following figures:

6 cm. spool averaged 31 knots pr. yard. Lumen 4.58 cm.

Lumen of 10 meshes (cm.): 4.0, 4.2, 4.3, 4.5, 4.6, 4.7(2), 4.8, 5.0(2), average 4.58 cm.

A measurement on net made the second time on the 10 cm. spool gave the following figures:

10 cm. spool averaged 19.36 knots pr. yard. Lumen 8.42 cm.

Lumen of 10 meshes (cm.): 8.2 (4), 8.4, 8.5 (4), 9.0, average 8.42 cm.

These figures give the following values of th two constants in the equation:

$I = 0.546$ cm., $R = 0.05$ cm.

The curve corresponding to these second measure ments has also been included in the diagram.

(After perusal of Dr. Russell's report wit appendices, Capt. Thor Iversen asks to hav the following note appended the above contribu tion:)

The new and very interesting experiment carried out by Mr. F. M. Davis and describe in Appendices B, C and D, seem to confirm tha the statement of Commandant Beaugé is unco rect. Conversance with those experiments does n cause any change of opinion as expressed abov

I have particularly noted that Mr. Davi seems to have proved correct (App. D) m statements in "Some Observations on Fry in Traw Catches in the Barentz Sea" (Rapp. et Proc. Verb Vol. LXXXV, part 3, page 1), that a trawl wit larger mesh will not lose in catching power o large and marketable fish, but that it will mor probably gain. Also, I note with interest Mr Davis' statement in Appendix C: "It was obviou that considerable numbers of the fish in th covering bag were undamaged and 'stron alive'."

ADDENDUM.

IN my paper "Some Observations on Fry in Trawl Catches in the Barents Sea" I have expressed the opinion that something would be gained by the introduction of a size of mesh in the cod-end of 2—3 knots less per Norwegian ell than what was generally used at that time by the British trawlers in the Barents Sea.

If it is assumed that the general mesh size in use before the new British Order under the Sea-Fishing Industry Act of 1933, in force from August 1st of the same year, was 25½ knots per yard when fishing, 2—3 knots less per Norwegian ell would correspond to 22½—21¼ knots per yard of net when fishing. In my paper it has furthermore been mentioned that 14 knots per Norwegian ell, corresponding to 20½ knots per yard, would allow small haddock of about 30 cm. to escape.

From the experiments carried out by Mr. F. M. Davis with a cod-end measuring 21 knots per yard when fishing it appears that 50 % of the haddock are released at a length of 24 cm., 25 % at 25.2 cm. and less than 1 % at 33 cm. The largest haddock released was 36 cm. This shows that 20½ knots per yard will not release any really large numbers of haddock at 30 cm. The experiments by Davis likewise show that my suggestion of a mesh of 22½—21¼ knots per yard when fishing will not release that size of fish which it would be desirable to release in the Barents Sea, where in my opinion we should particularly try to save the size-group 25—35 cm. of haddock.

With the intention of familiarizing myself with what sizes of young cod might be released under the most favourable conditions, I have carried out some preliminary experiments. These experiments have been performed with some young living cod of various sizes. Each cod was slipped through a net with meshes of varving sizes until the mesh was found giving the fish just the possibility of escaping, the mesh being distended in the way most advantageous to the fish. Each specimen was measured as to total length, greatest height, largest width and largest circumference. The table and figure appended give the result of this experiment. The position of the mesh proving most advantageous to the fish was the quadratic one. The meshes were therefore in each case distended as tightly as possible into a square, and the fish was slipped through the mesh with the height of the fish in a diagonal position. The internal length of the mesh was measured when stretched as tightly as possible fore and aft, and the corresponding number of knot per yard was read off the diagram published in Appendix III above: "Some Remarks on Mesh Width and its Influence on Young Fish", using the average curve of the diagram.

From the results which I am acquainted with from the investigations by Davis, it appears that a cod seems to require a somewhat larger mesh than does a haddock of the same length in order to escape. The one haddock in the table confirms this. The precise relation I have not had the opportunity to ascertain.

I would readily agree that I ought to have had more extensive material in constructing the table. It is also possible that the converting of lumen into knots per yard by means of the diagram will not agree exactly with the nets used in commercial fishing, as fluctuations are liable to occur in nets made by hand. However, I believe that the number of knots per yard relative to the size of the fish as shown in the table, are not far from the correct ones and may in any case be used as a preliminary indication.

When towing the net the meshes in the cod-end now in use cannot be assumed to distend in the most favourable manner, i. e. on the square. Thus it cannot be reckoned that all the fish which according to the table should be able to escape really do so. On the other hand it must be conceded that only a comparatively small percentage is released, which fact also seems to appear from the investigations by Davis. The meshes therefore have to be made larger in case it should be required to release 50 % of fish of a length chosen in the table.

If a practical and efficient way could be found of bringing the meshes into a more square position when the net is being towed than is the case in the cod-ends now used, it would be possible to attain better results. More particularly I am considering the possibility of arranging the cod-end in a manner different from the one used at present in such a way that in particular the top net would form a larger bunt. It is surmized that the major portion of the young fish escapes through the meshes of the upper surface of the net.

As previously mentioned it would in my opinion be very desirable to have a size of mesh in the cod-end which would allow the saving of an appreciable number of haddock and cod between 25 cm. and 35 cm. in the Barents Sea. And in order to be able to achieve this it would be necessary to use a cod-end with considerably larger meshes than is represented by 21 knots per yard. Special investigations such as those carried out by Davis in the North Sea would solve the problem of what size of mesh is the adequate one for this purpose. As to my view of the case I may refer to the figures in the table as an orientation.

In my paper "Some Observations on Fry in Trawl Catches in the Barents Sea" I ventured to point out that special regulations concerning the mesh size in the cod-end could probably be enforced in regard to the fishery in the Barents Sea and similar far-off waters, where the great distances from the market cause the small fish to be rejected as valueless because of its slight keeping qualities.

According to the investigations by Dr. J. Lundbeck no cod below 40 cm. nor haddock below 35 cm. are, practically speaking, landed in German ports from the Barents Sea. It is only in very exceptional cases that smaller sizes of cod and haddock are brought to the market. Of 326,500 cod (64 trips) less than 0.13 % were of the group 36—40 cm. Of 1,333,100 haddock (63 trips) 0.17 % were of the group 31—35 cm.

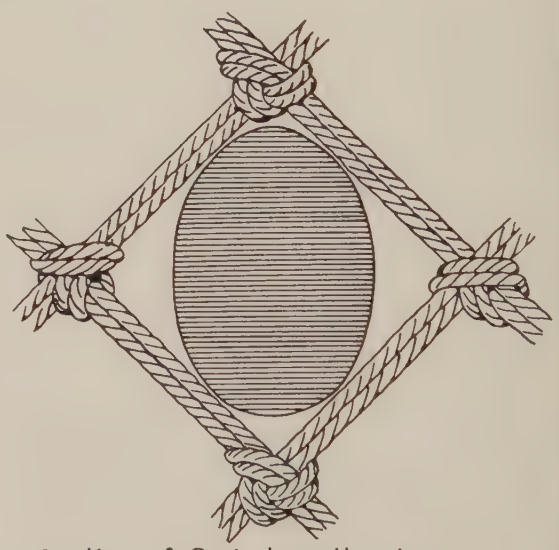
In his paper "Size Limits and Mesh Regulations for Sea-Fish", Dr. E. S. Russell has recommended for international acceptance a mesh-size of 21 knots per yard in the cod-end when fishing. He refers to the experiments carried out by Davis in the North Sea. 21 knots per yard are 3 knots less than what is in use today in conformity with British Order of 1933. This size of mesh seems to be very suitable for the North Sea in order to save young cod and haddock below 24 cm. the landing of which is prohibited in Great Britain under the Sea-Fishing Industry Act of 1933. However, a mesh-size represented by 21 knots per yard would of course not be adequate in protecting cod and haddock of the group 25—35 cm. in the Barents Sea. Here larger meshes have to be introduced, several knots less per yard than recommended by Russell.

But satisfactory information on this point will not be gained till investigations similar to those by Davis have been carried out. In my opinion it would be possible to introduce in a practical way a separate mesh regulation for the North Sea and similar waters and another mesh regulation for more far-off waters, including the Barents Sea.

Investigations of the Sizes of Small Cod (living) Released by Different Sizes of Mesh in the Cod-end.

Bergen, May 30th 1934.

Length	Circumference	Height	Width	Released at:	
cm.	cm.	cm.	cm.	Lumen cm.	Knots pr. yard
Cod:					
37.6	18.7	6.7	4.7	11.3	14¾
37.5	19.4	6.9	4.7	11.1	15
37.0	18.9	6.8	4.6	11.3	14¾
36.2	17.6	6.3	4.3	10.3	16
36.0	18.5	6.8	4.5	10.5	15¾
35.9	17.8	6.4	4.2	10.3	16
35.5	17.4	6.3	4.4	10.2	16¼
35.5	18.0	6.3	4.3	10.2	16¼
34.8	17.0	6.1	4.25	10.1	16¼
33.9	16.5	5.7	3.9	9.4	17¼
32.2	16.4	6.0	4.0	8.7	18½
31.7	16.0	5.9	4.0	8.7	18½
31.2	14.6	5.2	3.8	7.9	20
28.0	13.4	4.7	2.9	7.3	21½
Haddock:					
31.3	14.5	5.45	3.4	7.8	20¼



Section of Cod: Length 34.8 cm., circumference 17.0 cm., height 6.1 cm., width 4.25 cm..

Lumen of stretched mesh 10.1 cm.
Knots pr. yard 16¼.

IV.

CONTRIBUTION TO AN INVESTIGATION INTO THE MOST PROFITABLE SIZE-LIMIT FOR PLAICE IN THE NORTH SEA.

BY

AAGE J. C. JENSEN, COPENHAGEN.

THE OBJECT of a size-limit is, speaking generally, to protect the small and less valuable fish in order that they may attain the size at which the stock of fish will have the highest possible value to the fishery. Further, in some cases the object is to prevent the fish being caught before they have reproduced. As far as the North Sea plaice are concerned some slight influence of the number of spawning fish may be noticed on the amount of fry, but this influence is small in comparison with the fluctuations year by year in the amount of fry, due to variations in the physic conditions. At present, therefore, we may disregard any discussion of minimum size-limits for the purpose of preserving a sufficient breeding stock.

An investigation of the most profitable minimum must be made for each single fishery individually. Conditions vary with different fisheries, partly due to methods, and partly due to the fact that the prices obtained for plaice of a certain size change with the various fisheries. Quite a number of fisheries are of a local character and cannot be carried out profitably if too high a minimum size be imposed.

The Danish plaice fishery in the North Sea consists partly of a fishery for "live plaice", generally caught at the outer parts of the Horns Rev nursery grounds, and partly of a fishery which lands "iced plaice" from the open North Sea. In the following remarks the two fisheries will be considered separately.

A. Cutter Fishery for Live Plaice.

The conditions necessary for landing live plaice may be summarized as follows:

(1) Fishing must take place as near the coast as possible in order to make the return journey as quick as possible so that the plaice may avoid damage (in unsettled weather) during the transport from the fishing grounds to the port, (2) it must take place so far from the coast that sufficiently large fish may be caught in satisfactory numbers. Such conditions are generally present in area A 3 in the winter, and in area B 4, in the summer. About half of the Danish cutters, fishing in the North Sea, participate in this fishery. These cutters are for the most part the smaller ones.

The number of plaice in each cm. group decreases rapidly with increasing length, from 26 cm. upwards, and particularly is this so on those parts of the nursery grounds where this fishery is carried out. (Table 1).

The causes of this decrease in the number of plaice are mainly (1) that the fishery removes considerable amounts of marketable fish, and (2) that a number of plaice emigrate from this district as soon as they have attained a length of about 26 cm.

From the table it will be seen that the decrease in numbers of plaice between 25 and 35 cm. length, generally speaking, is about the same now as it was before the war, excluding the first couple of years after the war when the influence of accumulation of stock, due to a partly reduced fishing intensity, was noticeable.

Considerable fluctuations take place from year to year on account of the changing frequency of the year-classes. During the last couple of years an extraordinarily heavy decrease of plaice within the above mentioned length interval is undoubtedly due to the fact that the major part of the plaice of the rich 1928 year-class has been just below and about 25 cm. in length and that the previous year-classes have been considerably less numerous than the 1928 one. Moreover, the steadily increasing fishing intensity is also undoubtedly causing a steadily increasing quantity of plaice (more than 25 cm. in length) to be removed.

In the table a comparison is made of the decrease in numbers within the length interval 25—35 cm. prior to and after the war. The fishing intensity prior to the war was considerably less than after it. The number of Danish cutters fishing from Esbjerg during the years prior to and after

e war, and the average number of fishing days, ere as follows:

	Number of cutters	Number of fishing days
1903—1907	140	148
1923—1927	481	185
1928—1932	506	220

The single boats have also increased this ıtensity of fishing by increased average size, ıore powerful motors, increased length of seine nes, etc. The extension of the Danish fishery is articularly due to the development of the sea-oing fishery (the fishery landing iced plaice), ut the fishery on the nursery grounds is at present lso carried out with a highly increased intensity.

Table.

Percentage Distribution of Plaice between 25 and 35 cm. length in 2 cm.-groups caught by the Danish fishery investigations in the southern Horns Reef Area.

Year	25—26 cm.	27—28 cm.	29—30 cm.	31—32 cm.	33—34 cm.	No. of Stations
A. Spring, from 10—20 m. depth.						
1903	61	29	7	2	1	4
1904	75	24	0	0	0	1
1905	52	32	12	4	0	1
1906	40	39	19	3	0	1
1907	56	29	11	4	0	5
1925	66	23	7	3	1	6
1927	57	29	11	3	1	6
1932	80	19	1	0	0	10
B. Autumn, at various depth zones.						
1. Depth zone 10—20 m.:						
1903, 04	77	21	2	0	0	3
1925	55	23	22	0	0	5
1930	40	38	17	4	0	6
1933	72	22	4	0	1	6
2. Depth zone 20—30 m.:						
1903, 04, 05	65	24	8	1	2	5
1925	50	33	14	2	1	5
1930	56	29	11	4	0	5
1933	79	17	3	1	0	8
3. Depth zone 30—40 m.:						
1904	59	28	10	2	1	1
1925	62	26	8	4	1	4
1930	63	23	13	1	0	4
1933	96	4	0	0	0	2
4. Depth zone > 40 m.:						
1903, 04, 05	40	33	16	6	6	8
1925	39	34	19	6	2	3
1933	88	13	0	0	0	2

II. Percentage Distribution between 25 and 35 cm. length in 2 cm.-groups of Plaice caught from the cutter fishery of "live Plaice" at Esbjerg.

Year	Month	25—26 cm.	27—28 cm.	29—30 cm.	31—32 cm.	33—34 cm.	Total 25-34 cm.
1932	July	47	30	13	6	4	766
,,	Dec.	72	20	6	2	0	1327
1933	Jan.	73	20	6	0	0	188
,,	Febr.	76	20	3	0	0	652
,,	April	20	51	22	6	1	914
,,	June	36	39	15	5	3	476
,,	July	76	22	2	0	0	509
,,	Aug.	51	33	12	4	1	563
,,	Sept.	69	27	4	0	0	553
,,	Oct.	60	33	7	0	0	901
,,	Nov.	82	17	1	0	0	564
1934	Febr.	74	21	4	0	0	907

Further, the foreign fishery on the nursery grounds has undoubtedly also increased; Dutch, English, Belgian and German trawlers have, since the war, carried out fishing on the nursery grounds of Horns Rev to a very variable extent, but generally speaking it can safely be stated that it is hardly less than prior to the war.

The decrease in the stock of plaice between 25 and 35 cm. in length after the war is about the same as prior to the war, in spite of the fact that the intensity is now greater, and we must, therefore, assume that the decrease is due mainly to the plaice emigrating from this district. If we assume that the percentage of recapture inside the Horns Rev area of plaice of 25 cm. length marked in this area is about 50, and the growth is about 5 cm. in a year, we may reckon that the fishery will reduce a stock of plaice of 25 cm. length by about 15—25 % only in the time required for growth from "small" to "medium".

Part of the landings of live plaice is sorted by the wholesale merchants into 3 categories for sale on the home market. The average size of plaice in these market categories is as follows:

	1933			
	March	June	August	September
Small	26.6	26.8	27.0	26.8
Medium	29.0	28.1	29.7	28.1
Large	31.9	34.5	34.4	34.5

The difference in the average length between the sortings "small" and "medium" is 1 to 3 cm., generally somewhere about 2 cm. The weight increment of the single plaice in this interval is from 12—10 % for each cm.-group. The price per kilo of the "medium" size is about twice (1.6 to 2.0 times) that obtained for "small" and each plaice thus attains 2 to 2½ times as high a value by being allowed to grow from the average size of "small" to that of "medium". From the table, however, it may be seen that the decrease in number in the Horns Rev district between those

lengths, in some years has been ⅔ or ¾ even and thus, in spite of higher prices per kilo, it will not be a paying proposition to allow plaice to attain the length of "medium".[1])

As regards live plaice these conditions are still more strongly emphasized when we consider "medium" or "large". The weight increment of the single plaice in this interval is 150—200 % and the price per kilo for large is about 1½ to 2 times (1.4 — 2.2) higher than that for medium — in other words each single fish obtains 2¼—4 times as high a value by growth from "medium" to "large". However, as it will be seen from the table, in most years the plaice within this length interval seem to disappear from the Horns Rev district in so large numbers that a protection of the fish in the interval 28—34 cm. would not be a paying proposition for this fishery.

As regards plaice of about 24—25 cm. length a comparatively small decrease in number, with increasing length, takes place in this area, and it may therefore be assumed that the decrease in number may be balanced by an increase in weight, which is about 15 % for each cm. of growth, and by the fact that the value per kilo is greatly increased at about this length so much so that the value of one plaice of about 24 cm. is generally about one fourth to one fifth of the value of a plaice of about 27 cm. length. As to this point, however, it is very difficult to estimate the variation in value, as Danish minimum size regulations have checked the marketing of such size categories.

It is possible that an *international* minimum size of about 27 cm. would be able to protect the plaice in the Horns Rev district to such an extent that the stock of plaice above this limit would increase so much that it would be to the advantage of the fishery to introduce such a minimum size. Whether this be so the case can only be decided through investigations such as those above, and by the simultaneous marking of plaice during a series of years in the Horns Rev district; also by investigating the ratio between the value of plaice recaught and the value of fish marked at about 27 cm. length (See A. C. Johansen "Contributions to the Biology of the Plaice I, Medd. Komm. f. Havunders. Ser. Fiskeri, Bd. 1 Nr. 3 1905, p. 27) and by investigating how great a proportion of marked fish is at present caught by the fishermen before attaining this limit.

B. The Sea-Going Fishery (The Fishery landing Iced Plaice).

As regards the Danish fishery in the open sea from which iced fish are landed the present minimum sizes are only of minor importance f the purpose of limiting the landings, as this fishe lands only small quantities of plaice below 27 cm. length (the highest Danish minimum size f plaice). In respect of this fishery a still high minimum measurement than for instance 27 c would possibly prove more economical on accou of the fact that the value of each iced plaice abo 40—45 cm. length (1933) is 6—15 times as hi as that of a plaice between 27—30 cm., and 8— times higher than that of a plaice of about 27 c length.[1])

Concluding Remarks.

Considering the Danish fishery in the Hor Rev district it seems in some years at least to unprofitable to introduce an essentially high minimum measurement than that at prese existing, and particularly so if other countri participating in this fishing district keep a low size-limit. The Danish size-regulations are for t plaice fishery at the west coast of Denmark 26 cm., for export to England 27.5 cm. and for expo to other countries 24.5 cm.

If the introduction of a uniform internation minimum size is intended, it would possibly be the advantage of the fishery to fix this at 27 cm but this question requires further investigation.

Considering the total fishery, it is obvious harmful to the fishery in the open North Sea th the stock of small fish should be reduced on t nursery grounds before emigrating, but on t other hand higher prices are generally obtaine for live plaice than for iced plaice of the sam size and the live plaice have a large and ver specific market. An investigation as to the minimu sizes, which will give the most profitable yield, very complicated and most probably impossible t carry through, inasmuch as the national economica importance of the various fisheries should in th case be weighed against each other. Practicall speaking, in all cases, consideration of the mo profitable minimum sizes must be made in respe of each fishery individually.

It is a very great step forward that a more less satisfactory and more or less uniform siz limit has now been adopted by most of th countries participating in the North Sea fisherie It seems to me that this highly encourages th continuation of the investigation of the economi ally best size limit.

Therefore I should like to recommend th continuation of such investigations carried out o a purely practical basis, considering in the firs place each of the existing fisheries separately.

[1]) For information as to prices for the market categories of live plaice I am greatly indebted to the Association of Fish Exporters at Esbjerg (President Mr. A. Bachman, Wholesale-Merchant).

[1]) Calculated from weekly average prices obtained the auctions at Esbjerg 1933—34.

V.

SCOTTISH SEINE NET INVESTIGATIONS.

BY

ROBERT S. CLARK, ABERDEEN.

THE saving of undersized fish and the methods by which this object may be attained have formed an integral part of the scientific work the Fishery Board for Scotland. Much attention been devoted to the problem and many periments have been carried out with cod-ends of ferent sized meshes, all with a view to ascertain- their effect on the stocks of marketable species. e great importance of the haddock to Scotland, l to most other countries bordering the North , has led to that species claiming priority of ntion, while, of the methods employed in its ture, the Otter Trawl and, within recent years, Vigneron-Dahl Trawl and its modifications, e been concentrated upon. The results of these estigations have been communicated by Dr. w m a n to the Savings Gear Committee of the rnational Council and have appeared from e to time in Rapports et Procès-Verbaux. The n conclusions were:—

1) That of those fish which escaped during fishing operations the vast majority do so through the cod-end meshes, principally the last 16 ft.
2) that an increase in mesh of this section of the trawl results in a higher length size at which escape is possible; in other words, the cod-end, by the enlargement of the meshes, may be made to serve the purpose of a 'savings' gear.
3) that an increased mesh actually improves the catching power of the net for the larger sizes: or more precisely that the larger mesh captures a greater absolute number of larger fish for the same unit of fishing time.
4) that the V. D. Trawl has a higher catching power than the Otter Trawl, but with the same size of cod-end mesh catches the same sizes of fish with no difference in selective action.

Experimental tests have also been carried out with the "Snurrevaad" or Danish Seine and it is with this particular fishing gear, or rather the Whitefish Seine (a modified Snurrevaad used by Scottish inshore fishermen) that the present communication is concerned. The Danish Seine, following its adoption by Scottish fishermen in 1921, was tested in comparison with the Otter Trawl, on two marketable species, Haddock and Plaice; the results showed[1]) that while the Otter Trawl catches the larger sizes of Haddock and Plaice in the same proportion as the Danish Seine, it also catches considerable numbers of the smaller sizes which escape the Danish Seine. Thus the Danish Seine is less destructive of undersized fish than the trawl of equivalent cod-end mesh.

This mode of fishing grew in favour among the crews of small motor vessels, the fishery became more and more intense and the opening up of successive intra-territorial areas gave increased opportunities for the exploitation of the stock of adolescent plaice. Accordingly fuller information on all aspects of the problem became desirable if satisfactory regulation of this inshore seine net fishing were to be ensured.

The Whitefish Seine Net may be described as a combination of the Danish Seine and the old Flounder Seine[2]) worked in pre-war days by small sailing boats on Scottish inshore grounds. Both are designed on much the same principle, the essential difference being in the size of the net. There are, however, slight modifications in the working of the gear. The Whitefish Seine now used by small motor crafts (40 feet overall) operating principally within territorial waters, is about 24 yards long in each wing, 3 yards at the shoulders, depth at centre 8 ft. and at ends 3 ft.,

[1]) Rapp. et Proc.-Verb., Vol. LII, p. 231.

[2]) *vide* Report of the Scottish Departmental Committee on Trawling and Policing of Scottish Sea Fisheries, 1924.

bag and cod-end together having a length of about 8 yards. These dimensions are apt to vary a little with the locality and size of boat. The twine used is generally 12/12 for the wings, 12/15 shoulders, 12/18 1st sheet of the bag, 12/21 2nd sheet of the bag and 12/27 cod-end.

The Plaice is the mainstay of this whitefish seine fishery and though the East Coast of Scotland does not support a plaice population equal to that of the Southern North Sea, the Plaice nevertheless is of no small importance to our East Coast fisheries and claims a very considerable share of our attention.

The environment required by the plaice and the topography of the sea-floor along the Scottish East Coast combine to localise the bulk of the stock (consisting almost entirely of adolescent fish) within the territorial limit. This coincides closely with the 20 fm. line except in two localities. namely, a narrow zone outside Aberdeen Bay and the Bell Rock grounds east of St. Andrews Bay. There are long stretches of coast unsuited to the species. In the former area and especially towards the end of the year undersized plaice sometimes form a considerable percentage of the catches; and in the latter area, in the vicinity of St. Andrews Bay, the proportion of small plaice is always high. It is in this area that seine net experiments have been carried out.

For experiments of this nature the essential conditions are similar to those required for experiments with trawl cod-ends. Fish, especially of the critical sizes, must be numerous on the grounds. Large numbers of hauls must be taken with each net to minimise errors due to random sampling; while the same population must be sampled by each and all nets. Further, the most satisfactory means for ascertaining the degree of escape — the use of a small mesh net over the cod-end — cannot be applied successfully to seine nets. The seine net is too light and fragile to carry a small mesh covering without spoiling its efficiency and so the total population must be ascertained by other means. The best way is to use an Otter Trawl with a small mesh covering on the cod-end; and provided both types of gear are used at the same time on the same population, reliable selection curves for different meshed seines may thus be obtained. The conditions set forth above are not always available. The requisite numbers and sizes of plaice cannot always be obtained and long periods may elapse before all necessary requirements are fulfilled. The sampling of a plaice population of constant size distribution is more difficult than with haddock. Variations in depth so affect the size distribution of plaice that operations must be confined to ground of even depth and especially where the sea-floor shelves somewhat steeply. Otherwise we may merely be passing as the depth changes from one plaice population to another. Even in St. Andrews B ground of uniform depth, although greater extent than elsewhere along the Scottish East Coa is restricted.

Whitefish Seine Net Experiment I.

The main object of this experiment was obtain precise information regarding the co position of the catches of the Whitefish Seine N in certain specified areas during commerc fishing operations. The investigations were carri out during a period of ten days in August 1931 small motor seine net vessel, with two scienti observers on board, being chartered for the p pose. Both research vessels, the "Explorer" a "Enid" also participated, carrying out a trawli survey of the same grounds, the former in deeper water and the latter in the shallower dept in order to obtain data representative of the to population. The areas in which the investigatic took place were St. Andrews Bay and the p missible and closed areas in the Firth of For Experimental meshed nets were not employed this instance, a commercial net, having the follo ing mesh measurements, being used only:— Win and shoulders 4½″, Bag and cod-end 3½″, clos mesh inside knots.

The catches varied according to depth a locality. For all localities and depths combin the total number of fish taken by seine net w 11,456. Plaice constituted the bulk of the to catch with 83.0 %, Common Dabs contribut 6.4 %, Flounders 1.1 %, Lemon Soles 0.4 % Haddock 0.2 %, Angler 8.2 %, Other Kin 0.7 %.

The range in size of the total plaice populati on the grounds was 5 to 67 cm. No plaice small than 16 cm. was taken by the seine net althou in the shallower grounds these small fish occurr in considerable numbers. By utilising the ott trawl figures obtained by the research vessels was deduced that there was an increasi proportion of plaice retained with increasing si of fish, from a small percentage of fish of 16 c in length to complete retention for plaice of 22 c and over.

The percentage escapes were calculated follows:—

Plaice Percentage Escapes,
Whitefish Seine Net having Wings 4½″,
Cod-End 3½″.

%	100	75	50	25	
Length Size in cm.....	15	18.5	20.5	21.5	2

The other species on the grounds were n sufficiently numerous to provide further data to the selective action of the net.

The question of the blocking of the meshes of e cod-end affecting the chances of escape of the aller fish was also investigated. If this were e case, a steady rise in the percentage of smaller es should be indicated. The percentages of fish der 20 cm. and 25 cm., however, did not show gular increases with increase of catch, the ctuations about the mean being only such as e would expect to find in any series of hauls. ith a net such as was used in this investigation, ere the number of plaice taken did not exceed 5 in any single haul, the chances of escape of all plaice were not appreciably affected.

In connection with escape, attention was paid the kinds of fish and the estimated number of dividuals *observed* escaping through the wings d bag while the net was being hauled. Three ecies were involved — Plaice, Haddock and rnard. In the case of Plaice, escapes occurred re frequently in St. Andrews Bay where fish of all size were common. For twelve hauls ielding 3010 plaice) taken in this area, no plaice re observed to escape through the wing meshes. the other hand 80 plaice were seen to escape ough the meshes of the cod-end: These ranged m one to forty in number in single hauls. In e case of the maximum number of escapes the d-end was allowed to remain suspended on the face for several minutes during which time the jority of the escapes occurred. The number plaice taken in this haul was 556, of which were 20 cm. and under. Although no plaice re observed to escape through the meshes of the ngs, enmeshing on the wings occurred to the tent of a total of 14 fish for 70 hauls, while e number of plaice which escaped through the d-end meshes when the strain was released after e net was hauled on board was 38.

Haddock was represented at one position only d on two occasions entered into the question of cape. One of about 35 cm. (out of a catch of ven from 34—41 cm. in length) effected escape ough the wings and on the second occasion one 43 cm., the only haddock in the catch, was shed in the wings. Gurnards up to 30 cm. were served to escape through the cod-end meshes.

Several observations were made on the chances survival of undersized plaice as indicated by the haviour of the fish on return to the sea after rying intervals of time. All those liberated mediately the catch came on board and before ection for market began, showed great vitality. sults for intervals of 15 to 30 minutes (by which he selection of the catch was generally com-ted) varied and it was difficult to estimate the portion of probable survivors. Generally the jority appeared stunned and disappeared white e uppermost. The minority, which rarely exceed per cent., was active.

Although three coils (360 fathoms) of rope on each side is the normal length of rope used by small commercial seine net vessels, two coils (240 fathoms) were also operated. As measured by the time spent in actual fishing operations the use of three coils on either side was more effective than the use of two coils.

Whitefish Seine Net Experiment II.

With a view to further seine net experiments on the same grounds the "Enid" was adapted for seining purposes and a survey was carried out in October of the same year. The commercial net, with approximately similar mesh measurements to those in Experiment I, was again the only one used. The "Explorer" was utilised to obtain total population data. Fish were scarce on the grounds and only 1450 and 1125 Plaice, for Otter Trawl and Seine respectively, were taken during the three days' operations. These were sufficient, however, to confirm the results obtained in Experiment I. One of the most striking features of the experiments was the selective action of the Whitefish Seine with respect to the capture of the different species on the grounds. Small whitings, herrings, small gurnards etc. present in the otter trawl catches were almost entirely absent from those made with the seine net on the same grounds, the latter consisting almost exclusively of flatfish. Confirmation of the selective action of the seine on the small plaice population was obtained from an analysis of the catches of Common Dabs. All Dabs over 23 cm. in length were retained in the seine net, 50 per cent. at 20 cm. and all below 15 cm. escaping. The selective action of the seine net on the plaice population in respect of age-groups was determined as follows:—

Plaice — St. Andrews Bay. 10 fm. October 1931.

Age Composition of Catches of Otter Trawl (+ Small Mesh Covering) and Whitefish Seine.

		Otter Trawl			Whitefish Seine		
Year-Class	Age	Nos. Caught	%	Mean Sizes cm.	Nos. Caught	%	Mean Sizes cm.
1930	1	12	0.8	14.50	0	0	—
1929	2	776	53.5	18.01	416	36.9	19.32
1928	3	106	7.3	20.54	96	8.5	22.11
1927	4	543	37.5	24.51	607	53.9	24.51
1926	5	6	0.4	27.33	4	0.4	29.75
1925	6	7	0.5	35.57	2	0.2	35.00
		1450			1125		

The year-classes 1929 and 1927 were best represented on the grounds, the 1928 year-class being numerically weak. The commercial fishing in this area was, at that time, dependent mainly on the prolific 1927 year-class. The mean size of the 1927 year-class was the same for both nets but

for the 1928 and 1929 year-classes the mean sizes of those caught by seine net were higher than in the trawl, thus indicating that a proportion of the smaller sizes of both these age-groups was escaping capture by the seine net. The percentage age composition of the year-classes is thus affected,

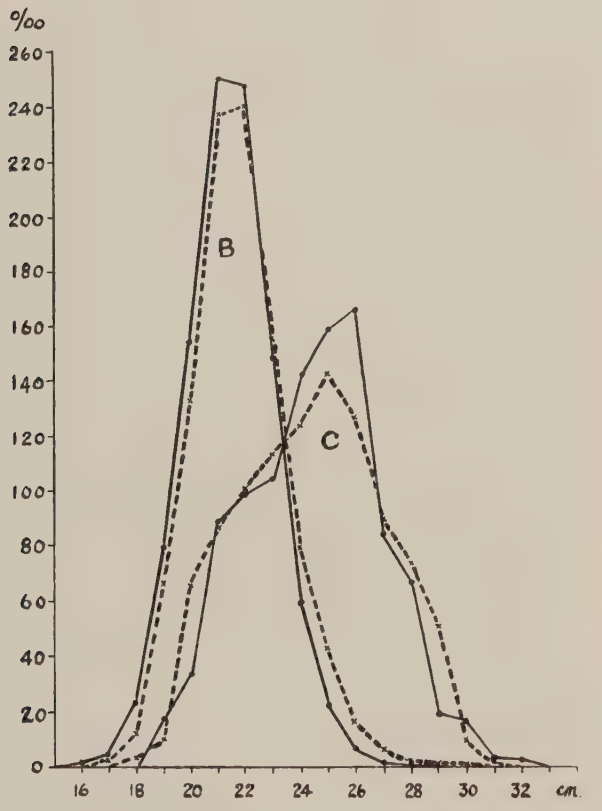


Fig. 2. PLAICE. Whitefish Seine Net Catches. Size Frequencies per 1000.

Wing Tests.

B. Seine Net 1. Wings 4¼″, Bag 3½″, Cod End 3″. Mean Size 21.48 cm.
Seine Net 2. Wings 5¾″, Bag 3½″, Cod End 3″. Mean Size 21.83 cm.

C. Seine Net 4. Wings 4¼″, Bag 4½″, Cod End 4¼″. Mean Size 24.49 cm.
Seine Net 5. Wings 5¾″, Bag 4½″, Cod End 4¾″. Mean Size 24.39 cm.

the younger groups being more weakly represented in the seine net than their actual proportions on the grounds.

St. Andrews Bay is an area of slow growth for plaice, and consequently the above results with respect to age composition do not apply to other sections of the Scottish coasts where the growth rate is higher. So far as Scotland is concerned, however, the entire 0-group and practically all the I-group are immune from capture by seine of

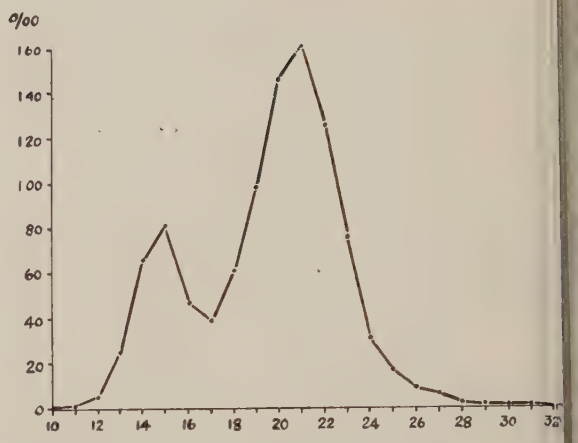


Fig. 1. PLAICE. Total Population (Otter Trawl. Sm Mesh Cover). Size Frequencies per 1000. Mean 20.56 cm.

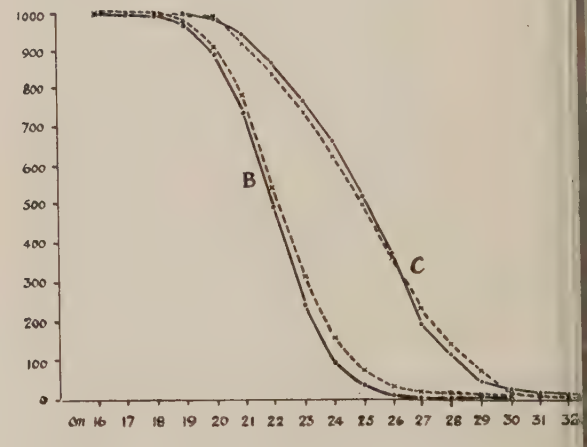


Fig. 3. As for Fig. 2. Cumulative per 1000.

3½″ (closed) bag mesh, while a proportion group II and a small quota of the slowest growe of group III also escape capture. This has be definitely ensured in Scotland by Byelaw regul ing the mesh of the wings at 2¾″ square and t meshes of the bag at 2″ square for intra-territori areas. The Byelaw also fixes the minimum landi size of plaice at 10 inches (25.4 cm.) and it w with a view to determining the size of seine n mesh, either in wings or bag and cod-end or combination of both, which would permit t escape of the maximum number below this si that the following experiment was undertaken September 1933. Prior to this date the essenti conditions, in the form of suitable numbers a sizes, for the carrying out of large sca comparative tests in a limited time were n present. Even on this occasion the higher critic sizes required for the testing of the larger mesh

eines were not so numerous as was desired, while dverse weather conditions and the loss of gear urtailed the programme considerably.

Whitefish Seine Net Experiment III.

St Andrews Bay.

The original series of comparative tests planned or this experiment comprised nine nets, but largely on account of the circumstances referred o above the number was reduced to five. These onsisted of the following combinations:—

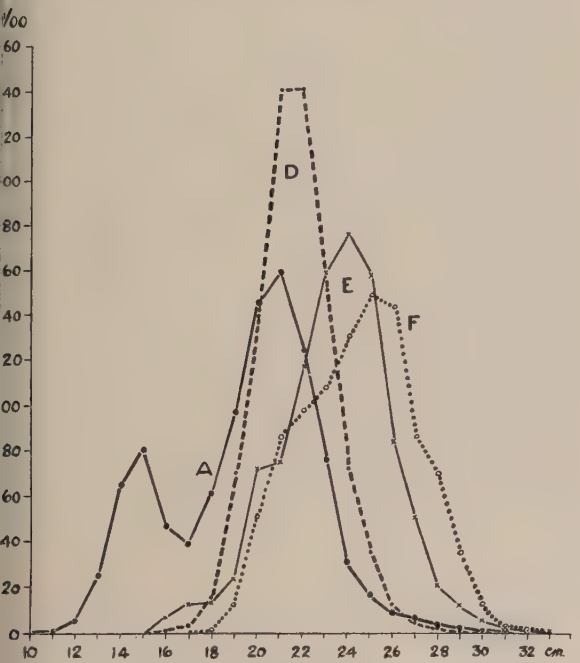


Fig. 4. PLAICE. Whitefish Seine Net Catches. Size Frequencies per 1000.
Bag and Cod End Tests.

A. Otter Trawl Small Mesh Cover (Total Population) Mean Size 20.56 cm.
D. Seine Nets 1, 2 (i. e. 3½″ Bag irrespective of Wings) Mean Size 21.70 cm.
E. Seine Nets 3 (i. e. 4″ Bag with 5¾″ Wings only) Mean Size 23.46 cm.
F. Seine Nets 4, 5 (i. e. 4½″ Bag irrespective of wings) Mean Size 24.40 cm.

Net 1.	Wings	4¼″	Bag	3½″	Cod-End	3″
,, 2.	,,	5¾″	,,	3½″	,,	3″
,, 3.	,,	5¾″	,,	4″	,,	2¾″
,, 4.	,,	4¼″	,,	4½″	,,	4¼″
,, 5.	,,	5¾″	,,	4½″	,,	4¼″

These are the mean measurements of the closed nesh inside knots. In this experiment differentiation was made between the bag of the net as istinct from the cod-end. In lineal measurement he former was ca. 16 ft. long (8/9 ft. each sheet) and the latter ca. 4 ft. The above series comprises two separate wing tests and three bag and cod-end tests.

The total plaice population, as ascertained by the Otter Trawl with small mesh cover is shown in the accompanying graph (Fig. 1). The sizes ranged from 11 to 33 cm. The two peaks in the graph represent, as shown later, the two dominant year-classes 1932 and 1931. The catches of the different seine nets, expressed per 1000 fish caught, had size frequency compositions as shown in Figs. 2—5. None of the seine nets captured plaice less than 16 cm. indicating that all fish below this size were effecting escape. From 16 cm. the percentage captured at each size (and, conversely, the percentage which escaped) varied according to the size of mesh of bag and cod-end, increase in mesh size producing a definite increase in escape

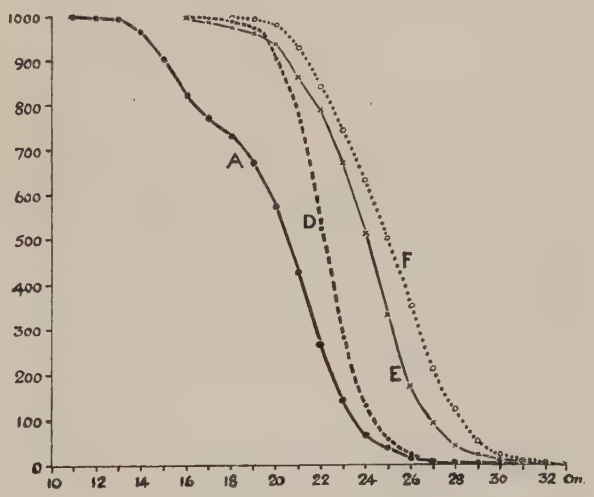


Fig. 5. As for Fig. 4. Cumulative per 1000.

both in number and in length of fish. The wing meshes would appear to have no appreciable influence on the sizes caught and this is illustrated in Figs. 2 and 3.

The results of wing test B show the size composition of Net I (wings 4¼″, bag 3½″) to be so similar to that of Net 2 (wings 5¾″, bag 3½″) as to be for all practical purposes identical. In both cases the mean size is practically the same, differing to the extent of only 0.35 cm. (in favour of the larger meshed wings), while Fig. 3 shows that for every 1000 fish taken, 500 are above the same size, namely, 22 cm. in both cases.

Similarly in Wing Test C. the catches of nets 4 and 5 (wings 4¼″, bag 4½″ and wings 5¾″, bag 4½″ respectively) are practically identical, the two different wings in combination with a bag and cod-end common to both produces the same type of result. Again in both cases the

mean size is practically the same, differing to the extent of only 0.1 cm. (in favour of the smaller wings), while in Figure 3 coincidence more or less along the whole range covered by the curve is indicated, with 500 out of every 1000 fish captured above the same size, in this case 25 cm.

The difference in the size frequency composition of the catches of the nets involving the two separate wing tests must therefore be attributed to the varying factor, namely, the bag and cod-end. In view of the results of the wing tests it is unnecessary, in the analysis of the bag and cod-end results, to consider the data concerning nets which consist of the same bag but different wings. The total catches of these may be combined and the size frequency composition of the totals for each of the three bags and cod-ends compared. These are given in Figures 4 and 5 from which it is evident that a definite relationship exists between size of bag and cod-end mesh and the sizes of fish which these take.

There is a decided progressive decline in numbers of smaller sizes occurring in the catches (or, conversely, an increase in escape) as the size of the bag mesh is increased, resulting in a corresponding increase in size composition. The increase in size composition is clearly illustrated in the mean sizes 21.70, 23.46 and 24.40 and also in Figure 5 which shows that for every 1000 plaice taken, 500 are over 22 cm., 24 cm. and 25 cm. for the 3½″, 4″ and 4½″ bags respectively. The selective action of the whitefish seine, with these sizes of bag meshes, on the plaice population as

inadequacy in numbers of the highest critical siz — 23, 24 and 25 cm. — and the fact that only minimum number of hauls was possible, preclud accurate results in the calculation of the percenta escapes at each cm. size, at least in the large meshed nets. Many more data than it was possib to obtain on this occasion will be necessary befo accurate selection curves can be produced. For t 3½″ bag + 3″ Cod-End first total capture si may be definitely fixed at 22 cm. — this resu having been obtained on all the experiments, b confirmation of the results for the 4″ and 4½ bags, particularly the latter, will require to obtained before the size at which total captu commences can be rendered conclusive. In th experiment these were 23.5 and 25 cm. respectivel

The results with respect to the nature of t plaice catches by the different nets giv indications that nets fitted with the larger meshe bags capture a greater absolute number of large fish on the same grounds for the same unit c time. Further experiments are planned to tak place this year when it is hoped that circumstance will favour the carrying out of fuller investigation

The action of the different sized seine nets o the plaice population with respect to age group was also investigated and the results are show in the following table. The age composition c the catches by nets consisting of different size wings but the same bag and cod-end was, as i size composition, practically identical. Accordingl the results with regard to age are given for th catches of nets irrespective of wings.

Plaice.

Age Composition of the Catches.

Net	Year Class 1932 Gr. I.		Year Class 1931 Gr. II.		Year Class 1930 Gr. III.		Year Class 1929 Gr. IV.		Year Class 1928 Gr. V.		Year Class 192 Gr. VI.	
	%	Mean Size	%	Mean Size	%	Mean Size	%	Mean Size	%	Mean Size	%	Mean Size
[1]) O.T. + S.M.....	24.37	14.96	70.48	20.70	4.39	23.60	0.64	24.92				
3½″ Bag 3″ C.E.	0.62	18.33	91.59	21.54	6.66	23.60	1.08	24.33	0.05	33.0		
4″ „ 2¾″ „	1.50	16.90	76.24	22.86	19.58	25.60	2.54	27.18			0.15	31.0
4½″ „ 4¼″ „			66.72	23.33	28.99	26.49	4.12	27.56	0.16	31.0		

[1]) O.T. = Otter Trawl.
S.M. = Small Mesh Covering on cod-end
C.E. = Cod End

constituted at the time of these experiments, may be gauged from the following table.

Plaice.

Percentage Captures under given sizes.

	under 15	20	25	30	35 cm.
O. Trawl + S. M. Cover...	9.7	42.5	96.2	99.9	100
3½″ Bag 3″ Cod End ...		9.1	94.0	99.6	100
4″ „ 2¾″ „ ...		5.8	66.2	98.9	100
4½″ „ 4¼″ „ ...		1.5	49.3	98.2	100

With regard to precise selective action, the

The age-groups on the grounds were I to VI or year-classes 1932—1927. The most outstanding group was Group II or year-class 1931, Group I or year-class 1932 being next in numerical strength The older year-classes 1929, 1928 and 1927 were poorly represented, 1928 and 1927 occurring only as individuals. Group I, it will be seen, is practically immune from capture by the two smaller nets and wholly so in the case of the largest meshed net. The larger meshed bags and cod-ends also permit escape of a greater proportion of Group II than the smaller meshed nets. In the

process, the mean size of those taken is raised to a higher level, while the extent of escape is reflected in the relatively greater proportion in the catches of the succeeding groups III and IV. That the smallest sizes of these groups are also effecting escape in the two larger meshed nets but are captured *in toto* by the smallest net is exemplified in the mean sizes in comparison with the trawl.

Size of Plaice in Relation to Size of Mesh.

Although length of fish is the only criterion which can be used for practical purposes to estimate the selective action of any net on the population, it is the breadth of fish (neglecting for the moment the thickness of the fish) which determines whether a plaice of given length may or may not escape through a mesh of given size. The question of the importance of the breadth factor, therefore, was gone into by the taking of measurements of breadth both inclusive and exclusive of marginal fins. Over one thousand plaice ranging from 7 to 45 cm. in length (sizes 7—9 cm. and all over 33 cm. from stations out-with the seine net experiments) were measured. Expressed as a percentage of total length, the breadth inclusive of marginal fins averaged 58.57 per cent. (range 55.36 to 63.23) while exclusive of marginal fins, the average was 38.16 per cent. (range 36.19 to 40.0). The following are the figures relative to breadth and length of the critical sizes operative in the selective action of the different meshed nets.

Total Length		Breadth			
		Inclusive of Marginal Fins		Exclusive of Marginal Fins	
Cm.	Inches	Cm.	Inches	Cm.	Inches
15	5.91	8.79	3.46	5.72	2.25
16	6.30	9.37	3.69	6.11	2.41
17	6.69	9.96	3.92	6.49	2.56
18	7.09	10.54	4.15	6.87	2.71
19	7.48	11.13	4.38	7.25	2.85
20	7.87	11.72	4.61	7.63	3.00
21	8.27	12.30	4.84	8.01	3.15
22	8.66	12.89	5.08	8.40	3.31
23	9.06	13.47	5.30	8.78	3.46
24	9.45	14.06	5.54	9.16	3.61
25	9.84	14.64	5.76	9.54	3.76
26	10.24	15.23	6.00	9.92	3.91

A comparison between the sizes at which first total capture is effected by the three different sized bags and cod-ends and the above breadth measurements of plaice, leaves no doubt that the breadth which determines whether a plaice may or may not be able to escape is that which is exclusive of marginal fins. Breadth, however, is not necessarily the sole determining factor: thickness must play some part. No data were collected with regard to thickness in relation to breadth and length and therefore the extent to which this factor operates can only be a theoretical one. Thickness of plaice may be discounted in the case of a mesh which opens wide but where the mesh conforms to an elongated diamond shape approaching a closed state, thickness becomes an important factor. The meshes of the bag and cod-end of the whitefish seine mostly bear longitudinally (as opposed to the wings which, as a rule, are hung vertically) and tend to be drawn into an elongated diamond shape varying in size of lumen according to pressure of water and strain to which they are exerted. It is not possible to say to what extent the meshes of the above three bags and cod-ends open during actual fishing and accordingly it is not possible to assess the importance of each of the two factors — breadth exclusive of marginal fins and thickness.

Conclusions.

In the comparison between Otter Trawl and Danish Seine, the results suggested that a number of escapes took place through the wings of the slower moving Danish Seine. During the progress of Experiments 1 and 2, no flatfish were observed to effect escape through the wings but a few were found enmeshed in this portion of the net. From Experiment 3 it would appear from the data available that the wings are of secondary importance where escapes are concerned and that escapes are effected mainly through the bag and cod-end. Though there may be a doubt as to the saving effect of the wings of the Danish Seine so far as flatfish are concerned, it seems quite clear from all the experiments so far made that a proportion of the plaice population escapes through the bag and cod-end proportions of the net and that an increase in the size of the meshes therein allows a greater proportion of smaller fish to escape. The main problem for this type of inshore fishery within Scottish territorial waters is to define the method of fishing so that the minimum number of fish just under 10 inches (25.4 cm.) will be caught by the net; in other words, that the maximum number of these sizes will escape from the net alive. If breadth and thickness of flatfish be deciding factors, a closed mesh approximately of 4½ inches inside knots in the bag and cod-end would be required to permit escape of the majority of plaice under 25 cm. in length.

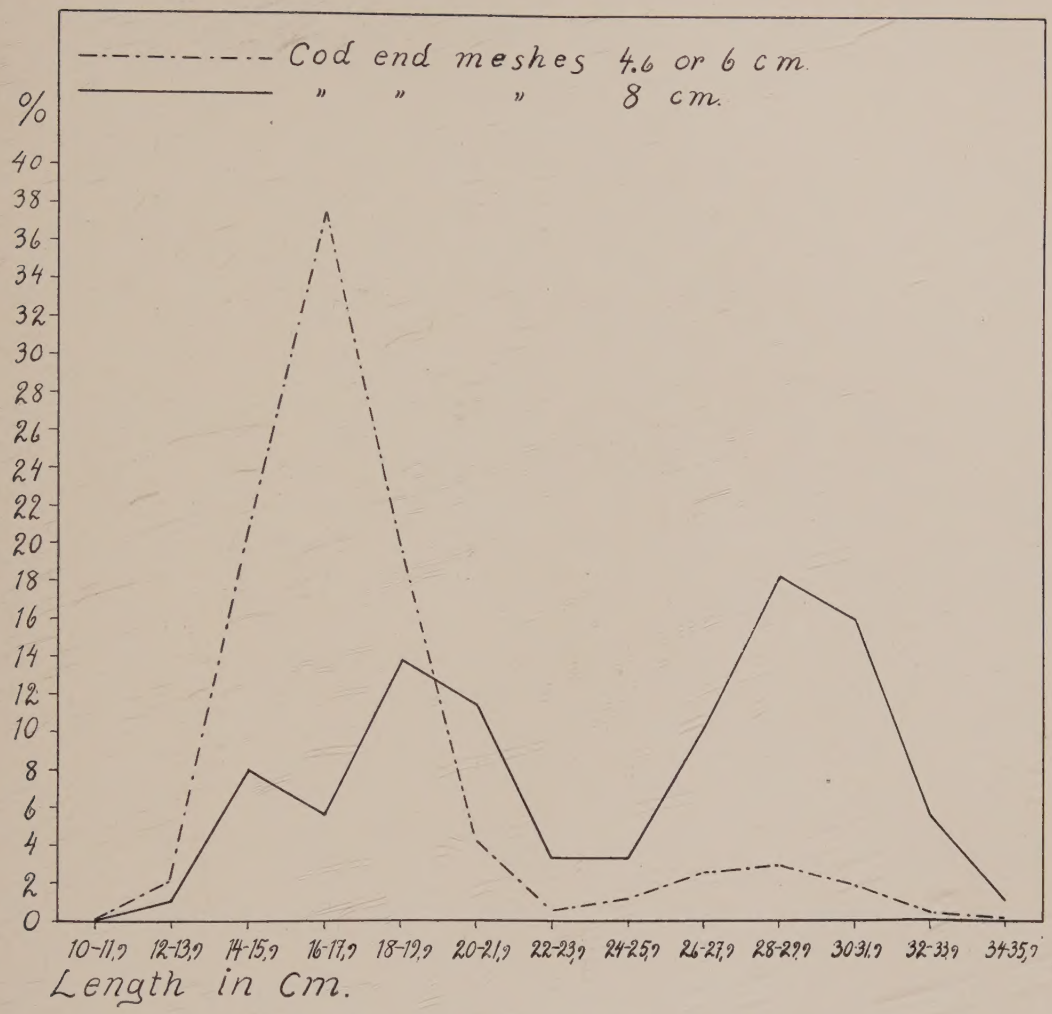
These experiments were planned by Dr. Bowman, and largely carried out by Mr. J. M. Lamont, Technical Assistant.

VI.

EXPERIMENTS WITH TRAWLS HAVING DIFFERENT MESHES IN THE COD-END.

BY

K. A. ANDERSSON.



Catches of haddock in the Skagerak and the Kattegat 1912—1914.

SOME twenty years ago the Swedish Hydrographic-Biologic Commission undertook quite extensive experiments in order to find possible means for saving unmarketable small fish during trawling. Also, the Swedish experiments on constructing a special saving-trawl may be considered well-known.

During the years 1912—14, a great number of experiments were also made with herring-trawl and the ordinary trawl. The former had meshes in the cod-end of width 2.3 or 3 cm., the latter 4 cm. between the knots. Parallel hauls were made with both trawls at the same place, with equal length of lines and at equal speed. The experiments were made in the Skagerak and in Kattegat.

The results of these simultaneous experiments are given in Fig. 1, showing percentage curves for haddock caught by both trawls.

Two facts are immediately recognized. The fine-meshed trawl catches considerably more small haddock, of 14—19 cm. The wide-meshed trawl catches a greater number of haddock, of 26—34 cm. length. These experiments seem to prove that trawls with wider mesh give a more valuable catch of haddock. It is obvious, though, that the trawls with larger cod-end mesh also catch a certain number of small haddock of length from 14—19 cm., but the number is insignificant as compared to that caught by the fine-meshed cod-end.

Catches of cod and whiting gave similar results in respect of saving small individuals, but they were not quite so distinct as to catch of greater individuals.

From the results of these experiments it seems evident that trawling for round fish would save the major part of small individuals between 14—19 cm. by using wider mesh in the cod-end, and also that the value of the catches, due to a greater number of large specimens, will increase by using a more wide-meshed cod-end.